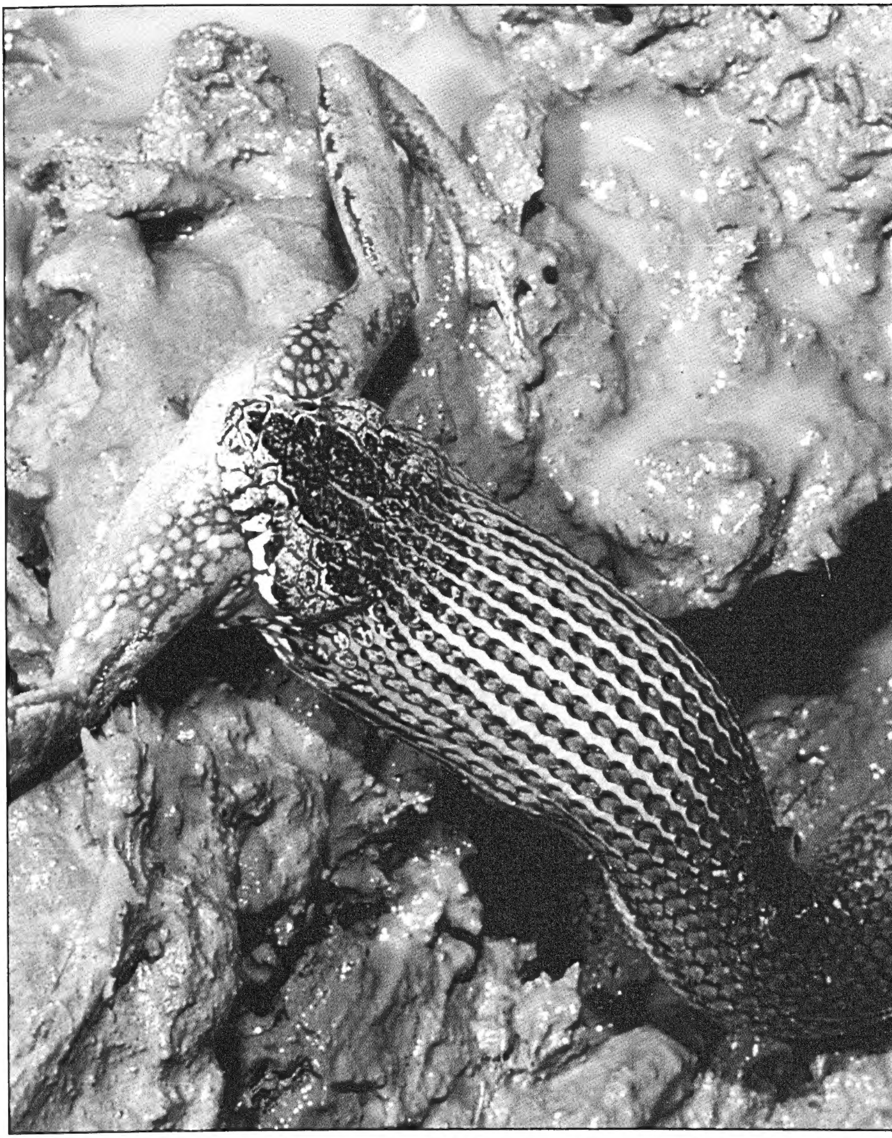
Price $8.00

HERPETOFAUNA

Volume 44 Number 1 and 2 **June and December 2014**



Ornamental Snake (*Denisonia maculata*) eating Striped Burrowing Frog (*Cyclorana alboguttata*), Croyden Station, Queensland (Photo: S. Wilson). See article on p. 8 on the distribution of the Ornamental Snake.

Herpetofauna is published twice yearly by the Australasian Affiliation of Herpetological Societies. The Affiliation started on an informal basis in 1974 and was formally established in 1977. It is the result of a formal agreement between member societies to participate in cooperative activities.

The Affiliation's objectives are to promote the scientific study of amphibians and reptiles and their conservation, to publish the journal *Herpetofauna*, to encourage liaison between societies at the regional level. It is not intended to be a separate society, nor is it to deplete member societies of their vital expertise and resources.

The seventeen member societies are:

ACT HERPETOLOGICAL ASSOCIATION INC.
Correspondence to:
PO Box 160, Jamison, ACT 2614

AUSTRALIAN HERPETOLOGICAL SOCIETY (INC)
Correspondence to:
PO Box R79, Royal Exchange,
Sydney, NSW 2000

CAPE YORK HERPETOLOGICAL SOCIETY
Correspondence to:
PO Box 2200
Cairns , QLD 4870

CENTRAL COAST HERPETOLOGICAL SOCIETY
Correspondence to:
PO Box 9040, Wyoming, NSW 2250

FROG AND TADPOLE STUDY GROUP OF NSW INC.
Correspondence to:
PO Box 296, Rockdale, NSW 2216

HAWKESBURY HERPETOLOGICAL SOCIETY INC.
Correspondence to:
Penrith BC, PO Box 680,
Penrith, NSW 2751

ILLAWARRA REPTILE SOCIETY INC.
Correspondence to:
PO Box 183, Albion Park, NSW 2527

MacARTHUR HERPETOLOGICAL SOCIETY INC.
Correspondence to:
PO Box 64N,
Campbelltown North, NSW 2560

NEW ZEALAND HERPETOLOGICAL SOCIETY INC.
Correspondence to:
PO Box 303140, North Harbour,
Auckland 0751, New Zealand

NORTH COAST HERPETOLOGY GROUP
Correspondence to:
PO Box 438,
Port Macquarie NSW 2444

REPTILE KEEPERS ASSOCIATION
Correspondence to:
PO Box 98, Gosford, NSW 2250

SHOALHAVEN REPTILE CLUB INC.
Correspondence to:
PO Box 6010, Kangaroo Valley, NSW 2577

SOUTH AUSTRALIAN HERPETOLOGY GROUP (INC)
Correspondence to:
c/- South Australian Museum,
North Terrace, Adelaide, SA 5000

TASMANIAN HERPETOLOGICAL SOCIETY
Correspondence to:
8 Clarke Street, Weymouth, TAS 7252

VICTORIAN ASSOCIATION OF AMATEUR HERPETOLOGISTS
Correspondence to:
8 Fellmongers Road, Breakwater, VIC 3219

VICTORIAN HERPETOLOGICAL SOCIETY INC.
Correspondence to:
PO Box 4208, Ringwood, VIC 3134

WEST AUSTRALIAN HERPETOLOGICAL SOCIETY INC.
Correspondence to:
PO Box 176, Woodvale, WA 6026

OFFICE BEARERS

Convenor Harald Ehmann
Editor Glenn Shea
Address for Correspondence P0 Box R307, Royal Exchange, Sydney, NSW 2000

CONTENTS

Volume 44 No 1 & 2

HERPETOLOGICAL NOTES

ISSN 0725-1424

Printed by Little Green Frog Print, Sydney (02) 9417 7633

Volume 44 was published on 30th May 2017

OBSERVATION OF HYBRIDISATION BETWEEN *PSEUDOPHRYNE AUSTRALIS* AND *PSEUDOPHRYNE BIBRONII* (MYOBATRACHIDAE)

Aaron Payne
Faculty of Education and Social Work, University of Sydney, NSW, 2006.
Email: apay6905@uni.sydney.edu.au

INTRODUCTION

Hybridisation in Australian anurans has been the subject of some study where contact zones may be critical in the dynamics of the speciation process (Littlejohn & Watson, 1985). Naturally occurring hybrids have been documented between some Australian species for example, *Litoria ewingi* and *L. paraewingi* (Smith *et al.*, 2013), *Crinia pseudinsignifera* and *C. subinsignifera* (Roberts, 2010) and *C. insignifera* and *C. pseudinsignifera* (Bull, 1978). Hybridisation has also been previously recorded in a number *Pseudophryne* species including in Bibron's Brood Frog (*Pseudophryne bibronii*) and the Red-crowned Brood Frog (*Pseudophryne australis*) (Woodruff, 1977, 1979).

The small myobatrachid frog *P. bibronii* breeds in ephemeral wetlands, ponds and drainage lines primarily in autumn and early winter. Breeding sites include chambers in the soil or amongst the roots of grasses and sedges (Anstis, 2013). The related Red-crowned Brood Frog (*Pseudophryne australis*) is largely restricted to the Triassic sandstone outcrops of the Sydney Basin (Thumm & Mahony, 1999). Breeding in *P. australis* usually occurs from spring to autumn in soaks, beside ephemeral creek lines in sandstone environments and in grassy swamps adjacent to these habitats. Both species exhibit terrestrial egg deposition in moist sites with male frogs remaining in the nest after the egg mass has been deposited. Within the Sydney Basin there is general habitat parti-

Figure 1. Hybrid male *Pseudophryne australis x bibronii*, Royal National Park, New South Wales.

tioning between these two species, where *P. bibronii* is usually absent from Triassic sandstone favoured by *P. australis*, instead preferring shale soils of the plains or on the tops of ridgelines (Woodruff, 1977). Occasionally in the latter habitat, both species co-occur and with an overlap in breeding period in the autumn months, there is potential for hybridization.

OBSERVATIONS

At 2000 hrs on 12 April 2014, five *P. bibronii* were observed calling from a small clay-lined depression in open woodland on a ridgeline in the Royal National Park south of Sydney (34.08578°S 151.03123°E). One frog calling beneath wet leaf litter in a small drainage line 2 metres away was located and was determined to be a hybrid of *P. australis* and *P. bibronii* on the basis of a combination of morphological characteristics (see below and Figure 1). A second calling frog was located in a small burrow in the clay banks of the adjacent depression and was morphologically consistent with *P. bibronii* (Figure 2). No *P. australis* were detected at the time of this visit however one calling male (Figure 3) was located in the same location as the hybrid frog on a subsequent visit on 3 June.

The hybrid frog exhibited morphological characteristics intermediate of *P. bibronii* and *P. australis*. These include an incomplete and orange crown (absent in *P. bibronii*, complete and red or orange-red in *P. australis*), orange armpits (often indistinct in *P. bibronii*, white or pink in *P. australis*) and a dark brown dorsal surface (raised ridges and small red tubercles in some *P. bibronii*, rounded red tubercles in *P. australis*). The ventral surface was strongly marbled with black and white on the belly but the throat was only faintly marked and lacked the distinct white patches present in *P. australis* in this area. The hybrid frog appeared healthy and demonstrated similar behaviours to the homospecific frogs such as using the typical 'crawling' method of locomotion, calling from a shallow depression in the leaf litter and the call was similar to that of *P. australis*.

Figure 2. Male *Pseudophryne bibronii*, Royal National Park, New South Wales.

DISCUSSION

Woodruff (1977) observed hybridisation between *P. australis* and *P. bibronii* at sites near Menai in southern Sydney. Searches by the author in recent years have failed to locate *P. bibronii* in this area although *P. australis* remains reasonably common in areas of suitable habitat. The observations in the Royal National Park here occurred approximately 8 km southeast of the sites reported by Woodruff and represent an additional example of hybridisation between these two species in southern Sydney.

Hybridisation with or without introgression has been suggested as a possible conservation threat when an abundant species comes into contact with a rare one (Rhymer & Simberloff, 1996). Woodruff (1979) suggests that hybrid zones can be "relatively ancient and are at equilibrium." This equilibrium can be maintained through selection against hybrids (such as embryo mortality) or through genetic influx from homospecific populations (Woodruff, 1979: 561). Divergence in breeding calls can serve as a sufficient pre-mating isolation mechanism in some anurans (Blair, 1964; Littlejohn, 1965). The calls of *P. australis* and *P. bibroni* are similar (Pengilley, 1971: 78) and where the temporal and ecological isolating mechanisms are not in effect there are likely to be very few barriers to hybridization between these two species.

A search of museum and atlas records yielded just four sites for *P. bibronii* in and immediately adjacent to the Royal National Park so this species is likely not to be as widespread as *P. australis*. One other site in the Royal National Park where *P. bibronii* has been observed in recent years is Jibbon Headland, approximately 13 km east of the site reported in this paper (M. Greenlees, pers. comm.). Since the original observations, opportunistic visits to the site after rainfall were made. In April 2014 the hybrid frog was relocated in the same location as it was previously found with only two *P. bibronii* observed calling from the clay-lined depression. Tadpoles were seen in May 2014 in the depression occupied by the P. *bibronii* but no water was present in the ditch where the hybrid frog was found. Only one male *P.*

Figure 3. Male *Pseudophryne australis*, Royal National Park, New South Wales.

bibronii was heard calling in March 2016 and no tadpoles were seen in subsequent months.

Degradation and disturbance of the site was apparent in the most recent visit. This disturbance seemed to be the result of illegal bike riding and the construction of new trails and jumps. These changes have affected the ability of the depression to retain water as well as impacted on where the males were observed to be calling. Recently, concerns have been raised about a possible decline in *P. bibronii* (Anstis, 2013), and the experience at this site shows that despite being within a protected area such as a national park, it is not immune to disturbance and negative impacts.

ACKNOWLEDGMENTS

Thanks to Christine Barnard for assistance in the field. Thank you also to Marion Anstis and Frank Lemckert for comments on the original manuscript.

REFERENCES

Anstis, M. 2013. Tadpoles and Frogs of Australia. New Holland Publishers, Sydney.

Blair, W.F. 1964. Isolating mechanisms and interspecies interactions in anuran amphibians. Quarterly Review of Biology 39: 334-344.

Bull, C.M. 1978. The position and stability of a hybrid zone between the Western Australian frogs *Ranidella insignifera* and *R. pseudinsignifera*. Australian Journal of Zoology 26: 305-322.

Littlejohn, M.J. 1965. Premating isolation in the *Hyla ewingi* complex (Anura: Hylidae). Evolution 19: 234-243.

Littlejohn, M.J. & Watson. G.F. 1985. Hybrid zones and homogamy in Australian frogs. Annual Review of Ecology and Systematics 16: 85-112.

Pengilley, R.K. 1971. Calling and associated behaviour of some species of *Pseudophryne* (Anura: Leptodactylidae). Journal of Zoology 163: 73-92.

Rhymer, J.M. & Simberloff, D. 1996. Extinction by hybridisation and introgression. Annual Review of Ecology and Systematics 27: 87-109.

Roberts, J.D. 2010. Natural hybrid between the frogs *Crinia pseudinsignifera* and *Crinia subinsignifera* (Myobatrachidae) from southwestern Australia defined by allozyme phenotype and call. Journal of Herpetology 44: 654-657.

Smith, K.L., Hale, J.M., Kearney, M.R., Austin, J.J. & Melville, J. 2013. Molecular patterns of introgression in a classic hybrid zone between the Australian tree frogs, *Litoria ewingii* and *L. paraewingi*: evidence of a tension zone. Molecular Ecology 22: 1869-1883.

Thumm, K.M. & Mahony, M.J. 1999. Loss and degradation of Red-crowned Toadlet habitat in the Sydney region. Pp. 99-108 in, Campbell, A. (ed.). Declines and Disappearances of Australian Frogs. Environment Australia, Canberra.

Woodruff, D.S. 1977. Hybridisation between two species of *Pseudophryne* (Anura: Leptodactylidae) in the Sydney Basin, Australia. Proceedings of the Linnean Society of NSW 148: 131-147.

Woodruff, D.S. 1979. Postmating reproductive isolation in *Pseudophryne* and the evolutionary significance of hybrid zones. Science 203: 561-563.

AN OBSERVATION OF COPULATING RUFOUS WHIPSNAKES (*DEMANSIA RUFESCENS*) IN THE WILD

Glen Gaikhorst and Erin Lynch
GHD Pty, Ltd., GHD House, 239 Adelaide Terrace, Perth, WA 6004.

The Rufous Whipsnake (*Demansia rufescens*) is endemic to the Pilbara region of Western Australia from Marilla north to De Grey River Station and Marble Bar in the north-east, and also on Hermite, Dolphin and Barrow Islands (Shea & Scanlon, 2007). It is a small species, up to 670 mm long with a copper to reddish-brown body colouration and a grey to olive grey head and neck (Storr *et al.*, 2002). The head has a pale-edged dark stripe across the snout with a pale ring around the eye merging into a comma shaped marking below the eye to the upper labials (Shea & Scanlon, 2007; Wilson & Swan, 2008).

This observation records the copulation of a wild pair of *D. rufescens* on 19 May 2011. The observation was made during routine checking of fauna traps at 8.15 am on Dixon Island (-20.616667S, 117.066667E) off the Pilbara coast. We note that Dixon Island could be considered an additional distributional record for Pilbara Islands , although it is connected to the mainland via mud flats during low tides. The specimens were not trapped but were observed while checking the fence line. The partly exposed body of a *D. rufescens* was seen between loose iron stone rubble; closer inspection revealed two snakes copulating. One of the snakes was slightly larger than the other (longer and stockier), approximately 60 cm, and the other was more slender and approximately 50 cm long. The male appeared to be the smaller animal. Both were intertwined with the cloacas slightly raised. The animals were not aggressive and we did not disrupt the pair more than necessary. The pair of snakes, still copulating, retreated backwards into a *Triodia* clump when they noticed us.

The habitat where this observation took place was typical of *D. rufescens*: *Triodia* spp. over iron stone ridges.

Little is known on reproduction of *Demansia spp.* in the wild. Scanlon (1991) recorded communal nesting behaviour in the Yellow-faced Whipsnake (*D. psammophis*) and oviposition of 3-9 eggs has been reported by Bush *et al.* (2010). Bedford (1992) recorded incubation and hatching of Lesser Black Whipsnakes (*D. atra*) (now *D. vestigiata*; Shea, 1998) from wild caught specimens maintained in captivity.

Copulation is rarely observed in wild snakes and in elapids is generally considered to occur in the later part of the year (spring period). This is consistent with *D. psammophis* and *D. torquata* that show ovarian follicle enlargement in spring (Shine, 1980). However, Shine (1980) also noted that *D. atra* (*D. vestigiata*) and *D. olivacea* potentially are able to breed throughout the year, with enlarged follicles not seasonally restricted (although his samples have subsequently been demonstrated to be a mixture of several species; Shea & Scanlon, 2007). Both of the latter species also fall within a tropical climatic zone which may alter reproductive events to their southern counterparts. Conversely, *D. vestigata* has also been recorded to be a spring seasonal breeder (Fearn & Trembath, 2009).

This observation occurred in May (autumn) within the Pilbara and suggests that *D. rufescens* may be capable of breeding throughout the year, similar to *D. olivacea*.

REFERENCES

Bedford, G. 1992. Notes on the incubation and hatching of the Black Whipsnake (*Demansia atra*). Herpetofauna 22(1): 24-25.

Bush, B., Maryan, B., Brown-Cooper, R. & Robinson, D. 2010. Field Guide to the Reptiles and Frogs of the Perth Region. Western Australian Museum, Perth.

Fearn, S. & Trembath, D.L. 2009. Body size, food habits, reproduction and growth in a population of Black Whip Snakes (*Demansia vestigiata*) (Serpentes: Elapidae) in tropical Australia. Australian Journal of Zoology 57: 49-54.

Scanlon, J.D. 1981. Community egg-laying by the Yellow-faced Whip Snake, *Demansia psammophis*. Herpetofauna 13(2): 25.

Shea, G.M. 1998. Geographic variation in scalation and size of the Black Whip Snakes (Squamata: Elapidae: *Demansia vestigiata* complex): evidence of two broadly sympatric species. The Beagle (Records of the Museums and Art Gallery of the Northern Territory) 14: 41-61.

Shea, G.M. & Scanlon, J.D. 2007. Revision of small tropical whipsnakes previously referred to *Demansia olivacea* (Grey, 1842) and *Demansia torquata* (Gunther, 1862) (Squamata: Elapidae). Records of the Australian Museum 59: 117-142.

Shine, R. 1980. Ecology of Eastern Australian whipsnakes of the genus *Demansia*. Journal of Herpetology 14:381-389.

Storr, G., Smith, L.A. & Johnstone, R.E. 2002. Snakes of Western Australia. Revised Edition. Western Australian Museum.

Wilson, S. & Swan, G. 2008. A Complete Guide to Reptiles of Australia. Third Edition. New Holland Publishing, Sydney.

THE ORNAMENTAL SNAKE (*DENISONIA MACULATA*): NOTES ON THE HABITAT AND POPULATION DENSITY OF A VULNERABLE ELAPID SNAKE.

Steve Wilson[1] & Gerry Swan[2]
[1]1042 Dayboro Road, Kurwongbah, Qld 4503.
[2]2 Acron Road, St Ives, NSW 2075.

INTRODUCTION

The Ornamental Snake (*Denisonia maculata*) is a small (maximum total length 465mm) nocturnal elapid snake endemic to mid-eastern Queensland in an area centred on the Bowen Basin, from the vicinity of Charters Towers, south to the Dawson River catchment (Figure 1.). It is associated with moist and seasonally flooded habitats. The species is listed as Vulnerable under Queensland and Commonwealth (EPBC) legislation and in the IUCN Redbook. Identified threats under the species' EPBC listing are: habitat loss; habitat fragmentation; habitat degradation by over-grazing by stock; alteration of landscape hydrology in and around gilgai environments; alteration of water quality through chemical and sediment pollution of wet areas; contact with the Cane Toad; predation by feral species, and invasive weeds (Department of Environment, 2013).

During construction of a gas pipeline from Moranbah to Townsville, and a water pipeline from Gorge Weir below the Burdekin Dam to Moranbah, a total of 144 specimens of *D. maculata* were among more than 980 snakes that were removed from open trenches. The published methodology and details described for the Moranbah to Townsville pipeline (Swan & Wilson, 2013) apply for both projects. *Denisonia maculata* were not uniformly distributed along these pipelines. Our data suggest *D. maculata* occur as dense populations within limited, sharply delineated areas of suitable habitat. Their presence is predictable based on habitat assessment.

Figure 1. *Denisonia maculata*, Moranbah area Qld. S. Wilson.

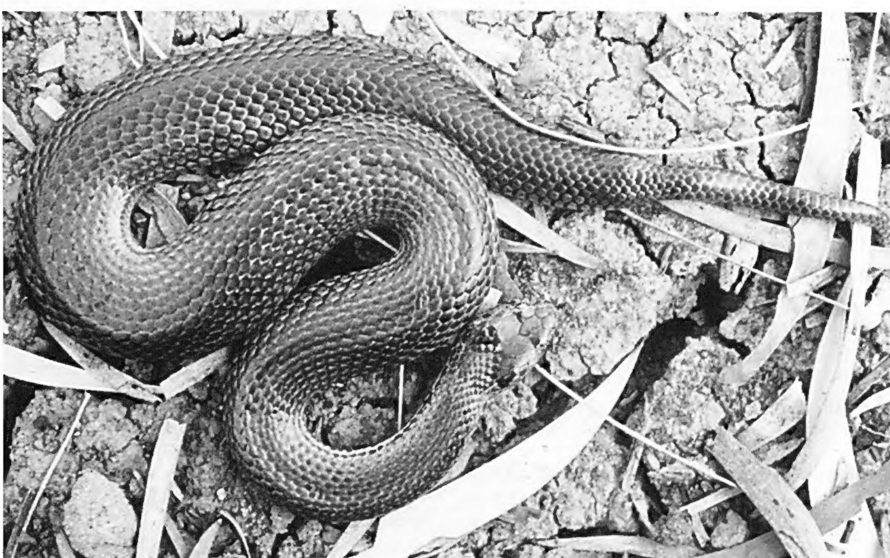
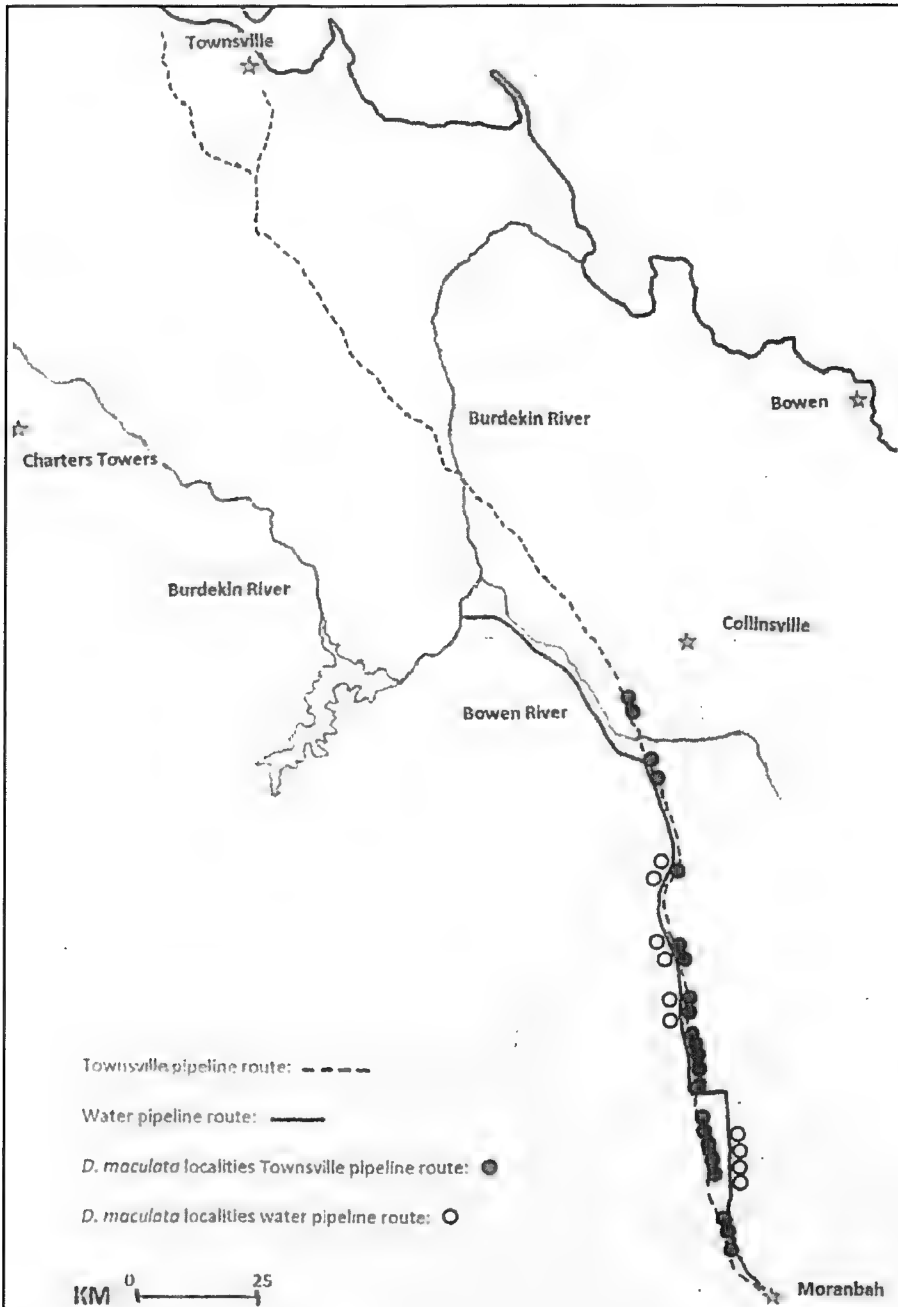


Figure 2. The pipeline routes and distribution of *D. maculata* along the routes.



We present information on habitat, documented and new potential threats, and comment on current status.

METHODS

A 392 km gas pipeline was laid from Moranbah (603575E 7569145N) to Townsville (479947E 7869040N) between April and August 2004, and a 218 km water pipeline was laid from the Burdekin (0530771E 7736845N) to Moranbah between March and November 2006 (Figure 2).

We were employed to remove and release fauna that fell into the trenches. A refuge-based system was used, placing moistened, sawdust-filled hessian sacks in the trench at approximately 250 m intervals. These offered stable, humid shelter sites and proved an effective way of daily monitoring up to 40 or more kilometres of open trench (Swan & Wilson, 2013).

Localities of all specimens were logged as Australian Map Grid References with a Garmin 12 GPS. Locality data were also linked with the surveyors' pegs marking 100 metre increments. During construction, the Moranbah to Townsville transect counted northwards between KP (Kilometre Point) 00 (Moranbah) and KP392 (Townsville). The Burdekin to Moranbah transect counted southwards between KP00 (Burdekin Dam) and KP218 (Moranbah). We have recalibrated the latter figures to count northwards, so all localities are measured as kilometres north of Moranbah.

RESULTS

On the Moranbah to Townsville pipeline, between 5 April and 6 June 2004, 103 *D. maculata* were recovered along a 141 kilometre stretch of trench from just north of Moranbah (KP13; 596716E 7579569N) to Myuna Station, about 20 km south-west of Collinsville (KP154; 572205E 7713436N) (Figure 2). In total 800 snakes of 20 species were removed from the trench. *D. maculata* was the second most numerous species encountered and was exceeded only by the Keelback (*Tropidonophis mairii*) with 266 individuals rescued.

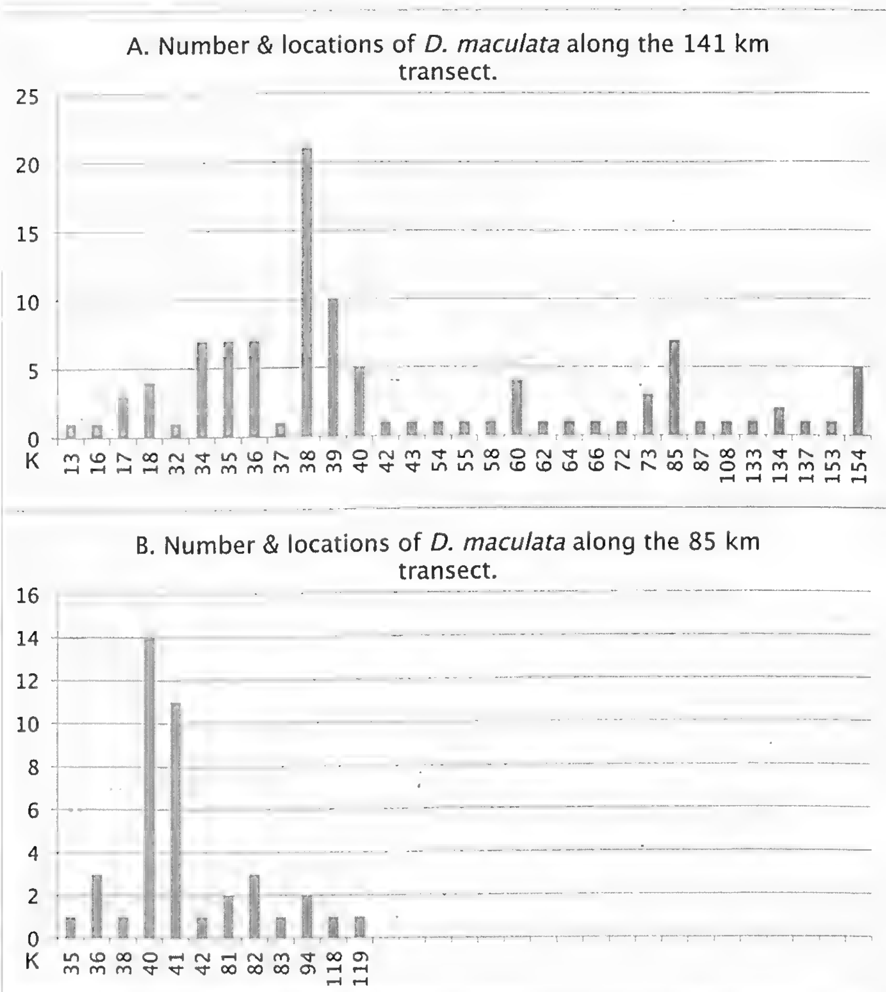
On the Burdekin to Moranbah pipeline, between 18 August and 10 November 2006, 41 *D. maculata* were recovered along a 84

Figure 3. *Denisonia maculata* habitat at KP 38 on Moranbah to Townsville gas pipeline.

kilometre stretch of trench north of Moranbah from KP35 (595200E 7599094N) to KP119 (585553E 7672835N) (Figure 2).

Denisonia maculata were not located uniformly along these transects. They were clustered on flood-prone, cracking clay soils (Figure 3). When present, they were often in high density, with 51 recorded along a 6 km stretch of trench on the Moranbah to Townsville pipeline, and 31 recorded along 8 kilometres of trench in the vicinity of Denham Downs Station on the Burdekin to Moranbah pipeline. Records ceased abruptly wherever there was a shift from the clay soils and where the low-lying ground profile rose above flood-prone sites. They re-appeared just as abruptly where terrain dipped back down to suitable habitat (Figure 4).

Figure 4. Numbers and locations of *D. maculata* along the 141km transect (A) and the 85km transect (B).



Both pipeline routes primarily traversed pastoral holdings so forested habitats were not impacted in the areas where *D. maculata* was likely to occur. Dominant vegetation at all sites where *D. maculata* were recorded was Brigalow (*Acacia harpophylla*), either cleared for pasture or in remnant stands. When all records from both pipelines are overlaid on a map of present and pre-cleared Brigalow occurrence (DSITIA, 2013), the association of *D. maculata* with this habitat becomes clear (Figure 5). It demonstrates that *D. maculata* is strongly reliant on land systems where Brigalow remains, and in cleared areas that were once dominated by Brigalow vegetation. All specimens were released down deep soil cracks. Despite their stocky build they vanished quickly and easily into these cracks.

Cane Toads (*Rhinella marina*) were common along both pipeline transects, but we only recorded actual localities for the toads encountered on the Burdekin Dam to Moranbah pipeline. Along this route, *D. maculata* and *R. marina* were no more than one kilometre apart at a one location and within the same Kilometre Point at three locations:

KP101: 2 x *R. marina*, and KP100: 2 x *D. maculata*

KP83: 4 x *R. marina* and 1 x *D. maculata*

KP82: 7 x *R. marina* and 3 x *D. maculata*

KP81: 1 x *R. marina* and 2 x *D. maculata*

DISCUSSION

Denisonia maculata (Figure 1) has generally been regarded as having a specialized diet and a limited distribution.

Shine (1983) found that frogs made up 95% of the diet of *D. maculata* examined. Frogs were plentiful in the trenches; 795 individuals of 14 species were taken from the 141 km Moranbah to Townsville transect. While we did not observe any direct predation within the trench, two snakes regurgitated specimens of *Limnodynastes tasmaniensis*.

McDonald *et al.* (1991), in an assessment of the status of Queensland reptiles, included *D. maculata* among the snake species confined or nearly confined to the Brigalow Belt of southern and central Queensland. In their words "beef cattle have tramped, eaten and defecated over most of the Brigalow Belt not used for agriculture or urban development."

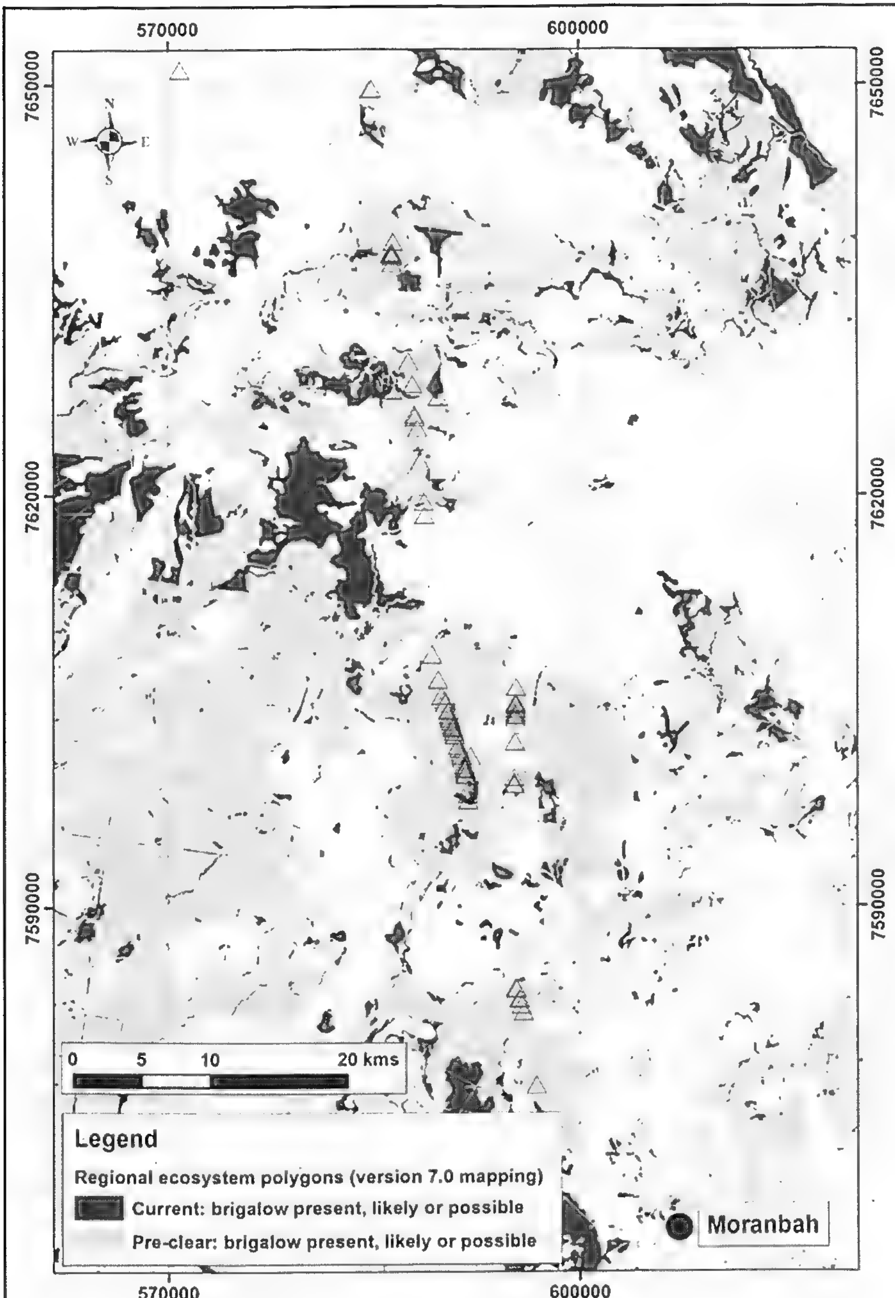
Cogger *et al.* (1993) in the Action Plan for Australian Reptiles concluded that *D. maculata* is... "Threatened probably by a combination of factors including overgrazing by stock, clearance of habitat for agriculture and grazing, pasture improvement, crop production, urban development and possibly poisoning by ingestion of cane toads."

New threats that can now be included relate to energy production. Many coal mines are planned throughout the species' range. Included are proposals for some of Australia's largest open cut mines. Habitat will be lost to the mine sites and associated infrastructure such as road and rail links and snake numbers may also be impacted by increased traffic. Coal seam gas production is also planned to increase, which would further fragment the habitat and add to traffic volume.

All of the *D. maculata* located along the pipeline routes were on freehold land allocated primarily to cattle grazing. Toads were also present, and sympatric at several sites where the snakes occurred. Despite these potential threats, *D. maculata* was the most abundant snake species found wherever low-lying substrate had a deeply cracking profile. This suggests that, at the time of the studies in 2004 and 2006, grazing and toads may not yet have had serious impacts.

Our records suggest that this nocturnal, habitat specialist occurs in high densities, concentrated on flood-prone cracking clay soils that support or have supported Brigalow. It is difficult to find by day using conventional means because favoured shelter sites are down deep cracks. Within our study areas populations appear to have persisted in the face of pastoral modifications and they remain common where Cane Toads occur. It

Figure 5. The occurrence of *D. maculata* along the pipeline routes overlain on current or pre-clear Brigalow habitat.



remains to be seen whether high numbers will be continue in the long term with these potential threats. And given the scale of planned coal mining, future impacts on its habitat are likely to be high.

The types of impacts from a mine and rail development which may be relevant include:

1. Hydrology could be altered – Prime habitat includes areas that are seasonally inundated.

2. Water quality could be compromised. Overflows during peak weather events, fuel spillage and sedimentation from earth works can all negatively affect water quality. In turn, this can directly affect the snakes.

3. The snakes' primary prey, frogs, are known to be sensitive to chemicals, water-born fungi and altered hydrology.

4. Populations may become isolated. Habitat fragmentation through clearing can result in reduced ability to traverse barriers such as rail lines, mine sites and broad swathes cleared for machinery access.

5. Habitat loss through filling of wetlands for infrastructure construction.

6. Traffic mortality. Increased number of vehicles will result in more road fatalities, particularly if these are near low-lying areas.

In view of these future impacts, coupled with the species' limited distribution and concentrated occurrence of individuals, *Denisonia maculata* should retain its status as Vulnerable.

In its favour, core habitats where dense populations occur are easily identifiable. Field surveys based on habitat can probably accurately predict the locations and boundaries of these populations. When planning for infrastructure during the development processes of future mines, roads and rail links, these sites can be identified and, where possible, avoided.

ACKNOWLEDGMENTS

We thank Graeme Hogarth, Rick Boreham and Norm Sewell of the North Queensland Gas Pipeline Alliance, Leon Richards and Dan Morgan of McConnell Dowell's Burdekin to Moranbah pipeline and the guys on the construction crews who accepted with good grace the antics of the 'snake whisperers'. Adrian Borsboom of Queensland Department of Science, Information Technology, Innovation and the Arts (DSITIA) provided access to and assistance with brigalow mapping.

REFERENCES

Cogger, H.G., Cameron, E.E., Sadlier, R.A. & Eggler, P. 1993. The Action Plan for Australian Reptiles. Australian Nature Conservation Agency, Canberra.

Department of Environment 2013. *Denisonia maculata* - Ornamental Snake. SPRAT Profile. In Species Profile and Threats Database, Department of the Environment, Canberra.
http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1193# threats

DSITIA 2013. Pre-clearing and 2009 remnant regional ecosystem mapping (version 7.0), Queensland Department of Science, Information Technology, Innovation and the Arts. Accessed November 2013, https://data.qld.gov.au

McDonald, K.R., Covacevich, J.A., Ingram, G.J. & Couper, P.J. 1991. The Status of Frogs and Reptiles. Pp. 338-345 in, Ingram, G.J. & Raven, R.J. (eds.). An Atlas of Queensland's Frogs, Reptiles, Birds and Mammals. Queensland Museum, Brisbane.

Shine, R. 1983. Food habits and reproductive biology of Australian elapid snakes of the genus *Denisonia*. Journal of Herpetology 17: 171-175.

Swan, G. & Wilson, S. 2013. The results of fauna recovery from a gas pipeline trench, and a comparison with previously published reports. Australian Zoologist 36: 129-136.

SYMPTOMS OF ENVENOMATION BY THE MITCHELL'S SHORT-TAILED SNAKE, *PARASUTA NIGRICEPS* (GÜNTHER, 1863) (ELAPIDAE)

Matthew Clancy
Deakin University, Burwood, Vic 3125.

INTRODUCTION

Mitchell's Short-tailed Snake (*Parasuta nigriceps*) is a small, terrestrial, nocturnal elapid snake with a distribution ranging throughout southern Australia's semi-arid regions; from central New South Wales, central and north-western Victoria, semi-arid South Australia and across to the south-western extent of Western Australia, favouring mallee woodlands (Swan *et al.*, 2004; Wilson & Swan, 2013). Being nocturnal, *P. nigriceps* feeds primarily on small lizards, however, blind snakes and small elapids (including conspecifics) have also been recorded as prey (Wilson & Swan, 2013).

Although *P. nigriceps* is relatively common throughout its distribution, because of its small size (350-590 mm total length (Wilson & Swan, 2013) and secretive nocturnal habits, it is rarely encountered by humans, and consequently recorded bites are rare.

A search of the literature failed to locate any published records of envenomation by *P. nigriceps*, however, discussion with Timothy Jackson of the Venom Evolutionary Laboratory, University of Queensland, Australia, has provided some unpublished data regarding compounds and toxicity of *Parasuta* venom.

Biochemical analyses of *Parasuta* venoms has shown them to be complex and rich in neuro- and myotoxins; very similar to those toxin classes present in larger, more dangerous elapids. Although the precise activities of venom in the various members of the genus *Parasuta* are yet to be tested, some have caused several potentially serious bites, with one recorded death possibly being the result of anaphylaxis. Venom composition within the genus is broadly similar and bites may carry severe consequences, especially from large individuals (Jackson *et al.*, 2013; T. Jackson, pers. comm.).

PERSONAL OBSERVATION

On the night of 2 November 2013, whilst surveying herpetofaunal activity at Big Desert Wilderness Park, Victoria, an adult *P. nigriceps* was seen crossing the road (Figure 1). This snake was particularly large (around 400 mm SVL) with a bulky head and believed to be female due to its more robust size and shorter tail-base (Shine, 2000). When attempting to photograph the animal before it could escape into a *Triodia* tussock, I was bitten on the small finger of my right hand as it approached the camera. The snake chewed momentarily before releasing my finger and fled into roadside *Triodia scariosa* tussocks. After the initial bite, a slight burning sensation confirmed envenomation.

Popular literature describes the venom of *Parasuta* spp. to be of little concern to human health and as a result of these statements, and the only minor initial burning sensation, medical attention was not sought (Swan *et al.*, 2004; Swan & Watharow, 2005; Wilson & Swan, 2013). Yet due to the bulkier size of the snake's head and believing that I had been envenomated, I immediately applied the currently recommended pressure immobilisation first aid procedure for Australian venomous snake bites (Wilson & Swan, 2013). A bandage was applied from the fingertips upward to the elbow and immobilised.

Approximately half an hour post-bite, minor localised swelling became evident. Fifteen minutes after these symptoms appeared my vision became slightly blurry. This was followed a few minutes later by nausea and vomiting which lasted around an hour. By two hours post-bite, remaining symptoms were

localised swelling, an intense and localised burning pain and minor aching pain throughout the entire right arm. The compression bandage was removed around 5 hours post envenomation, once I believed my condition was improving. The localised swelling, burning pain and ache lasted a few days before beginning to subside.

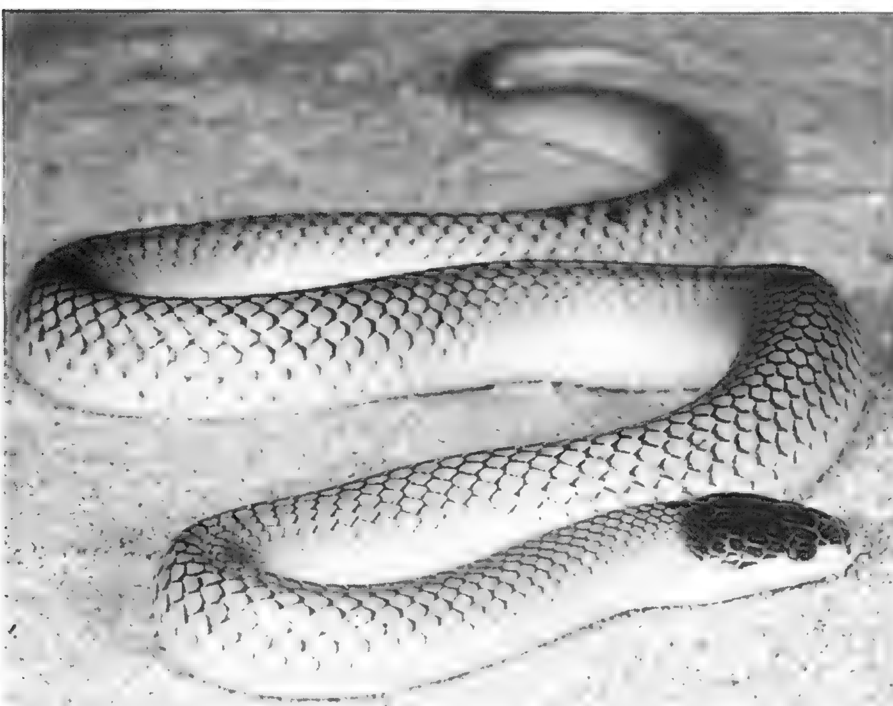
DISCUSSION

This bite record from a Mitchell's short-tailed snake (*Parasuta nigriceps*) presents an account of the symptoms of envenomation by an understudied Australian elapid snake. It also details the time period over which these symptoms occurred in an adult male, as inflicted by a large specimen and even with the currently recommended pressure immobilisation first aid applied.

Parasuta venoms contain complex neurotoxic and myotoxic compounds that may have clinical effects on humans. Severity and the extent of symptoms may depend on the amount of venom delivered. In the case of *Parasuta*, this may be considerable, as they chew and hold on to their reptilian prey to ensure penetration of the tough skin with their small fangs. Large specimens may deliver a severe and potentially fatal amount of venom in contrast to previous statements in the popular literature (T. Jackson, pers. comm.; pers. obs.).

People should exercise caution when interacting with *P. nigriceps*, due to the limited knowledge of its venom toxicity and impact on the health of humans. This personal account of envenomation and subsequent symptoms

Figure 1. Mitchell's Short-tailed Snake (*Parasuta nigriceps*), Big Desert Wilderness Park, Victoria. Individual responsible for envenomation. This individual largely lacks the broad dark mid-dorsal stripe typical of the species.



should be taken to provide a novel account of the possible medical issues that may follow envenomation by this species.

Small Australian elapid snakes, such as *Parasuta*, have not yet had their venom studied and documented in full, and the current literature stating that these snakes are virtually harmless (Swan *et al.*, 2004) should be reconsidered in light of the experiences recorded in this paper. Despite the limited interactions between *P. nigriceps* and humans, their potential for significant envenomation and its subsequent symptoms should be of public interest.

ACKNOWLEDGMENTS

I would like to thank Simon Watharow, Nicholas Volpe, Akash Samuel, Steven McNeil and Daniel van Horik for ensuring my welfare for the few hours after being bitten. Thank you also to Shawn Scott, Peter Homan and Aaron Payne for their helpful feedback on the manuscript. Additional thanks to Timothy Jackson for information regarding *Parasuta* venom.

REFERENCES

Jackson, T.N.W., Sunagar, K., Undheim, E.A.B., Koludarov, I., Chan, A.H.C., Sanders, K., Ali, S.A., Hendrikx, I., Dunstan, N. & Fry, B.G. 2013. Venom Down Under: dynamic evolution of Australian elapid snake toxins. Toxins 5: 2621-2655.

Shine, R. 2000. Australian Snakes: A Natural History. New Holland Publishers, Sydney.

Swan, G., Shea, G. & Sadlier, R. 2004. A Field Guide to Reptiles of New South Wales. Second Edition. New Holland Publishers, Sydney.

Swan, M. & Watharow, S. 2005. Snakes, Lizards and Frogs of the Victorian Mallee. CSIRO, Collingwood.

Wilson, S. & Swan, G. 2013. A Complete Guide to Reptiles of Australia. Fourth Edition. New Holland Publishers, Sydney.

FORAGING AND PREDATION OBSERVATIONS BY *VARANUS ROSENBERGI* MERTENS, 1957

Ryan J. Ellis
Department of Terrestrial Zoology, Western Australian Museum,
49 Kew Street, Welshpool, WA 6106.
Email: Ryan.Ellis@museum.wa.gov.au

INTRODUCTION

Australian monitor lizards (Squamata: Varanidae) are opportunistic carnivorous predators and scavengers with a variable diet, generally dependant on seasonal and geographic variation in prey presence and abundance (Bennett, 1998; King & Green, 1993; Losos & Greene, 1998; Pianka *et al.*, 2004). Predation on congeneric species and even cannibalism has been recorded in a number of species (King & Green, 1979, 1993; Pianka *et al.*, 2004).

Varanus rosenbergi is a large terrestrial varanid lizard (up to 1.5 m total length) occurring from Perth through the south-west of Western Australia across southern-western South Australia, with isolated populations in southern Victoria and eastern New South Wales (Bennett, 1998; Cogger, 2014; King & King, 2004). Within Western Australia the species is more common in the south-west of the state and scarce on the Swan Coastal Plain where it is at risk of further decline, predominantly from habitat degradation and removal due to urban sprawl and introduced predators.

Varanus rosenbergi has a wide-ranging foraging pattern across a variety of habitats, and often locates prey by scent, even when prey is hiding (King & King, 2004). King and Green (1979) showed the species has a highly variable diet consisting of a wide range of invertebrates and vertebrate prey items including amphibians, reptiles, birds (including eggs) and mammals. Previous study on the species' diet on Kangaroo Island in South Australia found that mammals (particularly rodents and macropods) and invertebrates (particularly Blattoidea, Acrididae, Coleoptera and Araneidae) contributed approximately two-thirds (33.3% invertebrates and 29.8% mammals) of the diet (King & Green, 1979). Reptiles contributed 21.5% of the diet and included various skinks (*Bassiana, Hemiergis, Lerista, Menetia, Morethia* and *Lampropholis* – King and Green's "*Leiolopisma metallicum*" is presumably *Lampropholis guichenoti* rather than *Niveoscincus metallicus*, which does not occur on the island; Armstrong, 1999), pygopods (*Aprasia*) and varanids (*Varanus*) in addition to a number of unidentified reptile species and reptile eggs (King & Green, 1979). Amphibians only contributed to 8.9% of the diet and consisted of a single *Limnodynastes* not identified to species (King & Green, 1979). The remainder of the species' diet consisted of unidentified birds or bird eggs (3.7%), plant material (2.8%) and a small quantity of rubbish. Cannibalism was also recorded with remains of a small *V. rosenbergi* in the stomach of one specimen; however, it could not be determined if the individual was consumed as prey or carrion. Rismiller *et al.* (2010) identified conspecific oophagy as common for *Varanus rosenbergi;* following deposition of eggs within termitaria, marauders would excavate and consume or destroy them when the opportunity arose. Examination of stomach contents of 33 specimens of *V. rosenbergi* from Western Australia revealed fewer vertebrate prey items than Kangaroo Island specimens with only a single individual containing mammalian prey (3%) and 7 containing reptiles or reptile eggs (21%), while 22 specimens (66%) contained invertebrate prey (primarily Coleoptera and Acrididae) (D. King, unpublished data in King & King, 2004).

This note describes four observations of foraging and predation by *Varanus rosenbergi* on other herpetofauna in Perth and the South-West regions, Western Australia.

OBSERVATIONS

Observation 1

During December 2010 at Forrestdale Lake, Perth (32°09'27.46"S 115°56'40.92"E) an adult *V. rosenbergi* was observed in the early morning crossing a sandy track through a small remnant patch of Banksia woodland surrounding the lake within the Forestdale Lake Nature Reserve. The monitor was observed from a distance as it walked slowly up the shaded track before stopping in an unshaded section exposed to direct sunlight, where it stopped and subsequently flattened its belly out on the warmer substrate and began to bask. It was alert and aware of my presence, moving a little bit farther up the track if approached too closely (within 12 m). Approximately four minutes later a previously unseen adult *Pogona minor minor* moved onto the track from fringing vegetation and stopped abruptly in the same area of unshaded track, approximately four to five metres from the basking *V. rosenbergi*. Almost immediately the monitor became alert and started tongue flicking. The *Pogona* appeared to recognise the monitor's movements and remained still for a few seconds before attempting to quickly move towards vegetation on the opposite side of the track. The *V. rosenbergi* immediately began pursuit and quickly caught up to the *Pogona*, capturing and swallowing the whole individual head first within a few seconds. Following the predation event, the *V. rosenbergi* moved up the track for a few meters further and stopped to continue basking again. It appeared to be much more alert at this stage and was easily disturbed upon my approach.

Observation 2

While undertaking a fauna survey in Fitzgerald River National Park (33°59'18.79"S 119°42'31.58"E) in the south-west of WA in March 2011, *V. rosenbergi* and *Egernia napoleonis* were frequently observed active around a base camp, particularly around a containment area for discarded food scraps and waste before it was removed from site. The camp was in an area inaccessible by the general public and the frequent presence of both species there was considered to be opportunistic due to the lure of decomposing food waste and the live food it attracted.

One afternoon three *E. napoleonis* were observed foraging on small invertebrates around the food waste, some successfully capturing flies. A juvenile *V. rosenbergi* that was a frequent visitor daily approached the area, tongue flicking rapidly as it approached. The monitor approached the area slowly and was alert to the presence of observers less than 10 m away. The skinks remained unaware of the approaching monitor until the predator was approximately 1.5 m away, when all three skinks retreated to cover, one under a nearby bucket lid on the ground and the others into nearby vegetation. The monitor approached a little closer and remained still, tongue flicking every few seconds. It did not approach the waste pile. After a minute or two, two of the skinks, presumably the same individuals observed earlier, emerged from retreat sites, one of them the individual that retreated under the bucket lid. The monitor remained still and tongue flicking appeared to cease. As the two skinks began foraging near the waste the monitor quickly moved in, attempting to capture one of the skinks. One was captured and consumed while the other escaped back under the bucket lid. The monitor began moving around the area, tongue flicking frequently. It gradually moved towards the bucket lid before pushing its snout under the edge of the lid and quickly lunging further under. The bucket lid flipped over and revealed the monitor consuming the second skink. Additional *E. napoleonis* and *V. rosenbergi* were observed during the remainder of the survey but no further observations of predation were made.

Observation 3

On an overcast day in October 2012 a juvenile *V. rosenbergi* was observed foraging in a remnant patch of bushland adjacent to Jandakot Regional Park, near Forrestdale Lake (32°09'35.59"S 115°55'7.08"E). The site contains remnant Banksia woodland habitat, but is heavily degraded from introduced weeds, vehicle access and dumping of rubbish. The monitor was observed foraging among a pile of building material and garden waste that had been dumped at the site. It was observed for a period of time foraging amongst the waste, regularly investigating around and under materials, tongue flicking rapidly. When the lizard reached a spoil heap of soil and garden waste approximately 2 m in length and 0.8 m in height it began to move back and forth along the edge of the pile as if it was honing in on a scent. After a few seconds it began to dig into the mound from one side, to a depth of almost 40 cm before emerging with a frog in its mouth. When the monitor had fully emerged from the hole it dropped the frog on the ground before nudging it with its snout and then consuming it. The frog was identified as *Heleioporus eyrei*. Two species of frogs were recorded in the same area of bushland on the day of the observation, one *Heleioporus eyrei* raked from a sandy spoil heap and two *Limnodynastes dorsalis* under a sheet of tin.

Observation 4

During a warm early morning in October 2014 at the same site as the previous observation, an adult *V. rosenbergi* was observed foraging among piles of dumped building materials, including sheets of tin and plasterboard. The monitor was previously disturbed while basking and remained very alert to observer presence; however, after approximately 10 minutes it explored the building materials, tongue flicking frequently. The monitor investigated the sheets of tin and would frequently push its head under the tin or plasterboard. After 10 to 15 minutes, it stuck its head under the edge of one piece of tin and suddenly forced itself further under the tin with only its tail tip remaining visible, moving erratically for a short period underneath the tin before emerging with a large adult *Pseudonaja affinis* approximately 1.5 m in length. The monitor gripped the snake at its midbody, about 60 cm from the snake's head, and began to vigorously shake its head with the snake in its mouth, causing the snake to hit the tin and sandy substrate a number of times intermittently over approximately 15-20 seconds. This intermittent shaking lasted about three seconds each time, with occasional short pauses where the monitor would raise its head slightly and check its surroundings or appeared to regain grip of the snake. The shaking appeared to have stunned or killed the snake and the lizard then dropped the snake to the ground. It then appeared to examine the snake, moving towards its head before picking it up by its head and consuming the snake, gulping a number of times to swallow it entirely. Following consumption, the monitor remained still in the sun for a few minutes before moving off into dense vegetation adjacent to the pile of dumped building material.

DISCUSSION

These observations add to the knowledge of foraging and predation behaviour of *V. rosenbergi* and increase the known range of prey records within its Western Australian distribution. As indicated by King and Green (1979), the species' diet is highly variable and likely to vary considerable depending on geographic location and seasonal changes; however, herpetofauna may contribute to the species' diet to a greater degree than previously identified by King and Green (1979) and Pianka *et al.* (2004) when the opportunity arises. The observations presented here indicate predation on lizards, and to a lesser degree snakes and amphibians may be more common in the southwest Australian population of *V. rosenbergi* than previous studies of Western Australian specimens (D. King, unpublished data in King & King, 2004) indicate.

Wide-ranging foraging behaviour and detection of prey by scent identified by King and

King (2004) is supported by the four observations published here. As an opportunistic predator, *V. rosenbergi* appears to use both visual and scent cues to detect prey, often from a distance by scent, and relying on vision when in close proximity to or pursuit of moving prey.

These observations also show the importance of remnant bushland in urban environments providing refuge for some species. Despite the degraded nature of the Perth based observation sites reptiles and amphibians are frequently recorded at remnant bushland sites, including, but less frequently, *V. rosenbergi*. While the species has continued to persist (though in low numbers) in some areas in remnant bushland across the Swan Coastal Plain, the ever growing threat of urban sprawl is likely to put more pressure on the species, from both predation and a decline of vertebrate prey species as a result of increased presence of cats in urban environments, and from the further reduction of the limited remaining habitat used by *V. rosenbergi*.

ACKNOWLEDGMENTS

I wish to acknowledge Brian H. Warner for encouragement to record these observations while in the field and J. Sean Doody for helpful discussions and comments on earlier drafts of this note. I also thank two anonymous reviewers for providing comments on this manuscript in preparation for publication.

REFERENCES

Armstrong, D.M. 1999. Reptiles & amphibians. Pp. 225-234 in, Robinson, A.C. & Armstrong, D.M. (eds.). A Biological Survey of Kangaroo Island South Australia in November 1989 and 1990. Heritage and Biodiversity Section, Department for Environment, Heritage and Aboriginal Affairs, South Australia, Adelaide.

Bennett, D. 1998. Monitor Lizards: Natural History, Biology and Husbandry. Chimaira, Frankfurt am Main.

Cogger, H.G. 2014. Reptiles and Amphibians of Australia. CSIRO Publishing, Collingwood.

King, D. & Green, B. 1979. Notes on diet and reproduction of the sand goanna, *Varanus gouldii rosenbergi*. Copeia 1979: 64-70.

King, D. & Green, B. 1993. Family Varanidae. Pp. 253-260 in, Glasby, C.G., Ross, G.J.B. & Beesley, P.L. (eds.). Fauna of Australia: Volume 2A Amphibia and Reptilia. Australian Government Publishing Service, Canberra.

King, D.R. & King, R.A. 2004. *Varanus rosenbergi*. Pp. 438-450 in, Pianka, E.R., King, D.R. & King, R.A. (eds.). Varanoid Lizards of the World. Indiana University Press, Bloomington.

Losos, J.B. & Greene, H.W. 1998. Ecological and evolutionary implications of diet in monitor lizards. Biological Journal of the Linnean Society 35: 379-407.

Pianka, E.R., King, D.R. & King, R.A. (eds.). 2004. Varanoid Lizards of the World. Indiana University Press, Bloomington.

Rismiller, P.D., McKelvey, M.W. & Green, B. 2010. Breeding phenology and behaviour of Rosenberg's Goanna (*Varanus rosenbergi*) on Kangaroo Island, South Australia. Journal of Herpetology 44: 399-408.

BRACHYUROPHIS AUSTRALIS IN THE DIET OF THE BANDY-BANDY (*VERMICELLA ANNULATA*) (ELAPIDAE)

James Fong
228 Broadwater Ave W Maroochydore, Qld 4558.

Working as a spotter catcher for the company SSSAFE (Snake and Spider Safety Awareness for Employees), I am often working in close conjunction with heavy machinery used for land clearing. At the time of this observation I was working on clearing access tracks for gas well pads in the Kogan area, south-east Queensland.

On 9 December 2013 at 0940 hrs, I was following a bulldozer clearing an access track on an area with spotted gums and small patches of brigalow scrub near a dirt road. The dozer tracks had churned up the soil and I noticed a small part of the body of a Bandy-Bandy, *Vermicella annulata*, exposed. I carefully excavated around the snake, which was unharmed.

As the head of the *Vermicella* was exposed it quickly regurgitated a dead Coral Snake, *Brachyurophis australis*. I relocated both animals to a nearby timber stack hoping that the *Vermicella* would later return for its meal. On inspection of the *Brachyurophis*, it seemed that it had not been fully swallowed yet and that I had interrupted the feed. Roughly the last quarter of the snake appeared to be perfectly dry.

Figure 1. *Vermicella annulata* with regurgitated *Brachyurophis australis*.

Figure 2. Comparative sizes of the two snakes.

Due to a "no handling snake" policy at this workplace, accurate measurements were not taken. However, the *V. annulata* was roughly 500 mm long and the *B. australis* was 210 mm.

Bandy-bandies are generally considered to primarily or exclusively feed on blind snakes (Typhlopidae). Stomach contents from eight *V. annulata*, one *V. intermedia*, one *V. multifasciata* and one *V. vermiformis* were exclusively of blind snakes (Shine, 1980; Keogh & Smith, 1996). Williams (1992) reported four captive *V. annulata* that consumed 93 blind snakes between them, but only a few other prey items.

There is a previous record of two *Vermicella annulata* regurgitating *Brachyurophis australis* in the field (Swan & Wilson, 2009). The record reported here suggests that this burrowing elapid species may be more than just an occasional part of the diet of bandy-bandies.

REFERENCES

Keogh, J.S. & Smith, S.A. 1996. Taxonomy and natural history of the Australian bandy-bandy snakes (Elapidae: *Vermicella*) with a description of two new species. Journal of Zoology 240: 677-701.

Shine, R. 1980. Reproduction, feeding and growth in the Australian burrowing snake *Vermicella annulata*. Journal of Herpetology 14: 71-77.

Swan, G. & Wilson, S. 2009. How specialized is the diet of the bandy-bandy *Vermicella annulata*? Herpetofauna 39: 103-106.

Williams, D.J. 1992. Remarks on the diet of the Bandy-Bandy, *Vermicella annulata*, in captivity. Sydney Basin Naturalist (1): 89-90.

NEW REPTILIAN HOST FOR THE REPTILE TICK *AMBLYOMMA LIMBATUM* NEUMANN (ACARI: IXODIDAE) FROM ALICE SPRINGS, NORTHERN TERRITORY

Inger-Marie E. Vilcins[1] and Julie M. Old[2*]
[1] Emerging and Acute Infectious Diseases Branch, Texas Department of State Health Services, PO Box 149347, MC 1960, Austin, Texas, 78714, USA.
[2] School of Science and Health, Hawkesbury Campus, University of Western Sydney, Locked Bag 1797, Penrith, NSW 2751, Australia.
*Corresponding author email: j.old@westernsydney.edu.au

Parasites impact on the survival of individual animals and populations, by decreasing health and nutrition and in the longer-term potentially reducing reproductive outcomes (Vilcins *et al.*, 2005). Ticks have been documented to reduce immunological fitness through parasitemia leading to anemia and blood cell abnormalities (Telford, 1984), reduced growth, survivorship and reproductive output (Madsen *et al.*, 2005). They have also been shown to impact behavior through their role as vectors (Bouma *et al.*, 2007).

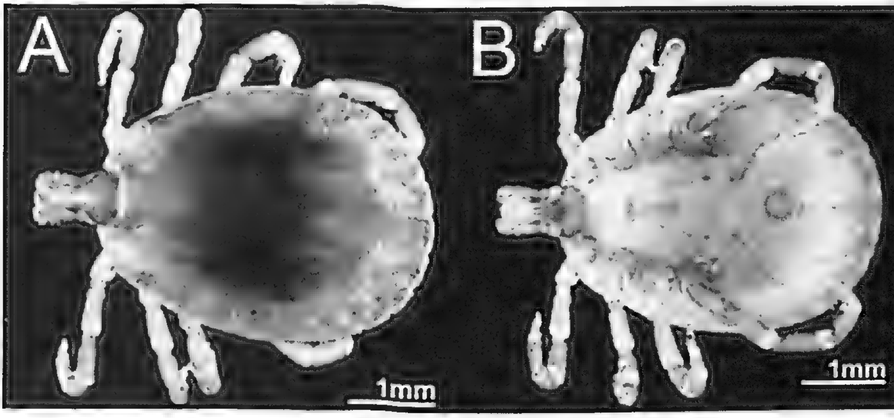
The Centralian Carpet or Bredl's Python (*Morelia bredli* Gow, 1981; Rawlings *et al.*, 2008) occurs in the arid southern parts of Northern Australia, ranging from Alice Springs to Uluru (Cogger, 2014). *Morelia spilota* (of which *M. bredli* is considered by some as a subspecies) is listed as Least Concern by the IUCN (2010), despite decreasing in number, whilst no conservation assessment has been provided for the Centralian Carpet Python. To date there have been no parasites recorded from *M. bredli* and relatively few from any *Morelia* species (Oliver & Bremner, 1968; Bull & Smyth, 1973; Smyth, 1973; Burridge & Simmons, 2003). This paper is the first to record any ectoparasite on *M. bredli*.

Ten male ticks were collected from a Centralian Carpet Python in March 2004, near Alice Springs in the Northern Territory (23°41'60"S 133°52'60"E). Ticks (Figure 1) were placed in 70% ethanol and later identified morphologically using keys (Roberts, 1970) and a compound microscope. The ticks were all identified as the Reptile Tick, *Amblyomma limbatum* Neumann (1899) based on the distinct anal groove embracing the anus posteriorly, eyes and festoons being present, long palpi, and a lack of adanal and accessory plates. The specimens were lodged with the Mite and Insect Collection, NSW Department of Agriculture, Orange.

Amblyomma limbatum, a member of the *A. triguttatum* species group (Barker *et al.*, 2014) is widespread in arid and semi-arid areas of Australia (Smyth, 1973). The tick parasitises a broad range of reptilian hosts, including varanids and snakes, and has been previously recorded from *Morelia spilota* (formerly Python *spilotes variegatus*) (Roberts, 1964; Smyth, 1973; King & Green, 1999; Vilcins *et al.*, 2009). A 17-year study of the co-habitation and boundary of *A. limbatum* with another tick species in South Australia found the species to be highly resistant to desiccation and capable of surviving in extreme xeric conditions for long periods, with temperature and humidity being the most important factors impacting on the survivability of ticks (Sharrad & King, 1981; Bull & Burzacott, 2001). The high resistance seen in *A. limbatum* enables them to await hosts in arid environments that are limiting to less tolerant species (Andrews & Petney, 1981; Sharrad & King, 1981; Bull & Burzacott, 2001).

Amblyomma limbatum can parasitise a broad range of hosts, survive extreme environmental conditions, and shows great flexibility in attachment sites (Chilton *et al.*, 1992), the species is a generalist. These factors also favour it as a vector for tick-borne obligate intracellular parasite transmission among reptiles, as evi-

Figure 1. A. Dorsal and B. ventral view of a male *Amblyomma limbatum* specimen collected during this study.



denced in the South Australian sleepy lizard (*Tiliqua rugosa*) (Wozniak *et al.*, 1996; Smallridge & Bull, 1999, 2000; Jakes *et al.*, 2003) and other native reptile species in the Northern Territory (Vilcins *et al.*, 2009). Further research is required to determine the role these ticks may play in the long-term survival of the Centralian Carpet Python in the wild and to determine the effects of any parasites potentially transmitted among reptiles in the region.

ACKNOWLEDGMENTS

We thank Gary Fry, Kim Branch and Greg Fyfe from Alice Springs Desert Park in Alice Springs, for their assistance in the collection of the samples and provision of invaluable information; Stephen Doggett, senior medical entomologist at Westmead Hospital in Sydney, for his assistance in the identification of the tick species and Peter Gillespie for entomological assistance. Thanks go to Chris Gillies from Biotrack for his assistance with tick photography. This research was funded by a RAACE Postgraduate Scholarship to Vilcins whilst at Macquarie University.

REFERENCES

Andrews, R.H. & Petney, T.N. 1981. Competition for sites of attachment to hosts in 3 parapatric species of reptile tick. Oceologia 51: 227-232.

Barker, S.C., Walker, A.R. & Campelo, D. 2014. A list of the 70 species of Australian ticks; diagnostic guides to and species accounts of *Ixodes holocyclus* (paralysis tick), *Ixodes cornuatus* (southern paralysis tick) and *Rhipicephalus australis* (Australian cattle tick); and consideration of the place of Australia in the evolution of ticks with comments on four controversial ideas. International Journal for Parasitology 44: 941-953.

Bouma, M.J., Smallridge, C.J., Bull, M. & Komdeur, J. 2007. Susceptibility to infection by a haemogregarine parasite and the impact of infection in the Australian sleepy lizard *Tiliqua rugosa*. Parasitology Research 100: 949-954.

Bull, C.M. & Burzacott, D. 2001. Temporal and spatial dynamics of a parapatric boundary between two Australian reptile ticks. Molecular Ecology 10: 639-648.

Bull, M. & Smyth, M. 1973. The distribution of three species of reptile ticks, *Aponomma hydrosauri* (Denny), *Amblyomma albolimbatum* Neumann, and *Amb. limbatum* Neumann II. Water balance of nymphs and adults in relation to distribution. Australian Journal of Zoology 21: 103–110.

Burridge, M.L. & Simmons, L.A. 2003. Exotic ticks introduced into the United States on imported reptiles from 1962 to 2001 and

their potential roles in international dissemination of diseases. Veterinary Parasitology 113: 289-320.

Chilton, N.B., Bull, C.M. & Ross, R.H. 1992. Differences in attachment site of the Australian reptile tick *Amblyomma limbatum* (Acari: Ixodidae) on two host species. International Journal of Parasitology 22: 783-87.

Cogger, H. 2014. Reptiles & Amphibians of Australia. Seventh Edition. CSIRO Publishing, Collingwood.

Gow, G.F. 1981. A new species of python from Central Australia. Australian Journal of Herpetology 1: 29-34.

IUCN. 2016. *Morelia spilota*. The IUCN Red List of Threatened Species. http://www.iucnredlist.org /details/62232/0 Accessed 22.vii.2016.

Jakes, K., O'Donoghue, P.J. & Cameron, S.L. 2003. Phylogenetic relationships of *Hepatozoon (Haemogregarina) boigae*, *Hepatozoon* sp., *Haemogregarina clelandi* and *Haemoproteus chelodina* from Australian reptiles to other Apicomplexa based on cladistic analyses of ultrastructural and life-cycle characters. Parasitology 126: 555-559.

King, D. & Green, B. 1999. Goannas. The Biology of Varanid Lizards. University of New South Wales Press, Sydney.

Madsen, T., Ujvari, B. & Olsson, M. 2005. Old pythons stay fit; effects of haematozoan infections on life history traits of a large tropical predator. Oecologia 142: 407-412.

Neumann, G. 1899. Revision de la famille des Ixodidés. Memoires de la Société Zoologique de France 12: 107-294.

Oliver, J.H. & Bremner, K.C. 1968. Cytogenetics of ticks. 3. Chromosomes and sex determination in some Australian hard ticks (Ixodidae). Annals of the Entomological Society of America 61: 837-844.

Rawlings, L.F., Rabosky, D.L., Donnellan, S.C. & Hutchinson, M.N. 2008. Python phylogenetics: inference from morphology and mitochondrial DNA. Biological Journal of the Linnean Society 93: 608-619.

Roberts, F.H.S. 1964. Further observations on the Australian species of *Aponomma* and *Amblyomma* with descriptions of the nymphs of *Amblyomma moreliae* (L. Koch) and *Amb. loculosum* Neumann (Acarina: Ixodidae). Australian Journal of Zoology 12: 288-313.

Roberts, F.H.S. 1970. Australian Ticks. CSIRO, Melbourne.

Sharrad, R.D. & King, D.R. 1981. The geographical distribution of reptile ticks in Western Australia. Australian Journal of Zoology 29: 861-873.

Smallridge, C.J. & Bull, C.M. 1999. Transmission of the blood parasite *Hemolivia mariae* between its lizard and tick hosts. Parasitology Research 85: 858-863.

Smallridge, C.J. & Bull, C.M. 2000. Prevalence and intensity of the blood parasite *Hemolivia mariae* in a field population of the skink *Tiliqua rugosa*. Parasitology Research 86: 655-660.

Smyth, M. 1973. The distribution of three species of reptile ticks, *Aponomma hydrosauri* (Denny), *Amblyomma albolimbatum* Neumann, and *Amb. limbatum* Neumann. I. Distribution and hosts. Australian Journal of Zoology 21: 91-101.

Telford, C.R. 1984. Hemoparasites of the Reptilia. CRC Press, Gainesville.

Vilcins, I-M., Old, J.M. & Deane, E.M. 2005. The impacts of ticks and tick-borne diseases on naïve animal species in Australia. Microbiology Australia 26: 76-78.

Vilcins, I.-M., Ujvari, B., Old, J.M. & Deane, E.M. 2009. Molecular and morphological description of a *Hepatozoon* species in retiles and their ticks in the Northern Territory, Australia. Journal of Parasitology 95: 434-442.

Wozniak, E.J., Kazacos, K.R., Telford, S.R. & McLaughlin, G.L. 1996. Characterization of the clinical and anatomical pathological changes associated with *Hepatozoon mocassini* infections in unnatural reptilian hosts. International Journal of Parasitology 26: 141-146.

AN OBSERVATION OF REPRODUCTIVE BEHAVIOUR OF *ANILIOS AUSTRALIS* GRAY, 1845, THE FIRST CONFIRMED OBSERVATION OF COPULATION BY AN AUSTRALIAN TYPHLOPID SNAKE.

Ryan J. Ellis[1] and Rodney A. Boyle[2]
[1] Department of Terrestrial Zoology,
Western Australian Museum, 49 Kew Street, Welshpool, Western Australia, 6106.
E-mail: Ryan.Ellis@museum.wa.gov.au
[2] 3255 Stoneville Road, Stoneville, Western Australia, 6081.

INTRODUCTION

Blindsnakes (Typhlopidae) remain one of the least known and understood Australian squamate taxa. This is most likely linked to the cryptic nature of blindsnakes and difficulty in obtaining specimens for study. Reproductive behaviour including copulation, same-sex combat and oviposition or parturition is relatively well documented for most other snake genera in Australia, particularly pythons and elapids; however, the reproductive behaviour of blindsnakes remains unknown and poorly documented. Courtship and mating has never been observed directly for any Australian blindsnakes (Ehmann & Bamford, 1993; Greer, 1997). Despite no direct observations of courtship or mating taking place, aggregations of multiple adults of both sexes have generally been interpreted as reproductive behaviour (Greer, 1997). Hoser (1980) documented five observations of *Anilios* species aggregations with reproductive behaviour inferred despite the sex not being determined for most observations and copulation not being observed; however, he also noted that the aggregations may serve purposes other than reproduction. Shine and Webb (1990) reported mixed sex aggregations of *Anilios nigrescens* and *A. weidii*, which were assumed to be related to breeding behaviour while Scanlon and Davidson (1999) reported a breeding aggregation of *A. nigrescens* in which copulation was inferred as both sexes were determined within each aggregation; however, copulation was not confirmed in either study. Shea (2001) reported "a single male and female entwined with apposed vents" where mating was also inferred despite copulation not directly observed.

A study of museum specimens combined with field and captive observations of live specimens by Shine and Webb (1990) revealed seasonal reproductive cycles with vitellogenesis occurring in spring (September to November) and oviposition occurring in summer (December to February). Ehmann and Bamford (1993) suggested mating occurred below the surface due to the fossorial nature of *Anilios* and the lack of documented observations of mating. Maryan (1988) presented information on a gravid female *A. australis* collected and subsequently laying, with incubation and hatching of the clutch of eggs. Five eggs were laid in late January and incubated at 29±4°C. Hatching occurred from mid-March over a period of five days following an incubation period of 55-59 days. Maryan (1988) also reported clutch sizes ranging from two to seven eggs for this species.

Anilios australis (Southern Blindsnakes) are moderately large (total length to 450 mm), robust blindsnakes endemic to south-west Western Australia. The species is distinguished from other *Anilios* by the number of ventral and midbody scales, in addition to morphology and positioning of head scales. Here we present an observation of reproductive behaviour of *A. australis* and describe the first confirmed observation of copulation by the species at Glen Forrest near Perth, Western Australia.

OBSERVATION

The observation took place while undertaking a general clean-up of a property in Glen Forrest near Perth, Western Australia (31°54'34"S 116°06'15"E) on 24 November 2014. At approximately 1400 hrs during garden maintenance on the property, some objects were removed and disposed of, including a multi-layered piece of black polyethylene plastic which was covering the ground in a small open area adjacent to low shrubby vegetation. The crumpled layers of plastic covered ~1.2 m^2. As the pieces were lifted, a small aggregation of blindsnakes was observed in a tight clump. The number of individuals present could not be determined immediately as they were tightly coiled around each other. The substrate below the plastic was flat and very dry. Small amounts of leaf litter were distributed in patches below the plastic. Within 10 seconds after raising the plastic and sighting the aggregation, one individual broke away from the group and moving out of the bright light to the cover of the lifted plastic.

The other two individuals remained tightly coiled and copulation could easily be observed (Figures 1-2). The two copulating individuals and the third individual were collected to obtain photographs of the behaviour. All three were removed to a shaded area about 15 m away and placed directly on the substrate. At this stage it was evident the third specimen was no longer attempting to remain part of the aggregation as it was extremely active in comparison to the other two individuals and moved towards cover relatively quickly. Upon returning from retrieving a camera (approximately 45 seconds later), the bucket was raised and the third specimen was gone. The remaining copulating pair was photographed (Figures 1-2). While being pho-

Figure 1. Copulating pair of *Anilios australis* from Glen Forrest (photo: R. Boyle)

tographed, the individuals remained tightly coiled together posteriorly and copulation was still occurring. Apart from some minor head movement the pair appeared unperturbed from initial observation, during handling and while being photographed. The pair remained conjoined when returned and covered with the bucket for protection. Copulation was observed taking place throughout the duration of the observation, a period of no more than four minutes.

The blindsnakes were identified as *Anilios australis* Gray, 1845 based on a rounded snout, large rounded rostral scale and moderately robust appearance, differentiating them from other species known to occur in the area.

The temperature at the time of observation was in the mid-20s (°C) with sparse cloud cover. No rain was recorded on the day of the observation. Climate data recorded at the Bickley weather station (BOM site 009240; 32.01°S 116.14°E) approximately 10 km south of Glen Forest, for 24 November 2014 was 24.4°C with 28% RH at 1500 hrs, from 15.7°C with 52% RH recorded at 0900 hrs (Bureau of Meteorology, 2014). In the five days preceding the observation, average temperatures ranged from 10.8-21.6°C with a total of 5.2 mm of rainfall recorded over three days, including 0.4 mm on 22 November (Bureau of Meteorology, 2014).

Figure 2. Copulating pair of *Anilios australis* from Glen Forrest, showing everted hemipenis (photo: R. Boyle)

DISCUSSION

This observation provides a further observation of aggregation behaviour by an Australian blindsnake species and reports the first confirmed observation of copulation. This observation suggests a reproductive period similar to most other reptiles in the Perth region with reproductive behaviour triggered by increasing temperatures following the cooler winter months and with copulation taking place during spring aggregations, agreeing with the timing of observations on other *Anilios* species (Scanlon & Davidson, 1999; Shine & Webb, 1990). Following the post-copulation events presented by Maryan (1988) and the observation detailed here, the reproduction timeline for *A. australis* is likely to commence in spring with mating taking place over September–November, laying in mid to late summer and hatching in early to mid-autumn.

Despite copulation not being observed by Scanlon and Davidson (1999), Shine and Webb (1990) or Shea (2001), it is likely the behaviour observed was related to reproduction and copulation may have been occurring, particularly Shea's observation where similar tightly coiled behaviour was observed with vents tightly opposing by two individuals; however, it is unknown why these aggregations occur and if they are related specifically to mating. Hoser (1980) indicated that aggregations may serve purposes other than solely for reproduction due to observations from various times throughout the year and noted aggregations occurring around spring are more likely to be reproductive aggregations. It is likely the other individual observed was a male as many breeding aggregations of snakes have been male-biased (Rivas & Burghardt, 2005; Whittier *et al.*, 1985) including previous observations of blindsnake aggregations (Scanlon & Davidson, 1999; Shine & Webb, 1990). Dispersal of males unsuccessful in mating has previously been observed in mating aggregations of the Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) (Friesen *et al.*, 2013; Whittier *et al.*, 1985).

Previous observations of aggregations and potential mating events indicate Anilios species may form similar reproductive aggregations to those observed in other snake species and pheromones may play an important role. Pheromones produced by females may play a significant role in attracting males or both sexes (based on mixed sex aggregations observed) for mating events to take place (Finneran, 1949; Fox, 1955; Rivas & Burghardt, 2005; Whittier *et al.*, 1985). It is likely scent plays an important role for blindsnakes as sensory stimuli with studies showing they will follow scent trails left by ants to locate prey (Webb & Shine, 1992) and blindsnake predators (*Vermicella* spp.) are known to follow the scent trails left by blindsnakes (Greenlees *et al.*, 2005). A number of studies have identified the ability of various species to follow pheromone trails left by conspecifics to locate mates during the breeding season (Fornasiero *et al.*, 2007; Graves *et al.*, 1991; Greene *et al.*, 2001). This allows for wide-ranging species to locate a breeding partner, and in the case of fossorial species such as blindsnakes, the use of pheromones is likely to be of significant importance in the location of a mate due to the reduced use of other sensory organs in a subterranean environment.

As previous records have assumed or inferred reproductive behaviour, and not actually observed copulation, this detailed observation is believed to be the first record of copulation by an Australian typhlopid snake.

ACKNOWLEDGMENTS

We thank Paul Doughty (Western Australian Museum) and Glenn Shea (University of Sydney & Australian Museum) for technical discussions and comments on earlier drafts of the manuscript.

REFERENCES

Bureau of Meteorology. 2014. Climate Data Online - Climate Statistics for Australian Locations. Commonwealth of Australia, Bureau of Meteorology, Melbourne. Available at: http://www.bom.gov.au/climate/data/

Ehmann, H. & Bamford, M.J. 1993. Family Typhlopidae. pp. 280-283 in, Glasby, C.G., Ross, G.J.B. & Beesley, P.L. (eds.). Fauna of Australia. Volume 2A Amphibia and Reptilia. CSIRO Publishing and Australian Biological Resources Study (ABRS), Canberra.

Finneran, L.C. 1949. A sexual aggregation of the garter snake *Thamnophis butleri* (Cope). Copeia 1949: 141-144.

Fornasiero, S., Bresciani, E., Dendi, E. & Zuffi, M.A.L. 2007. Pheromone trailing in male European Whip Snakes, *Hierophis viridiflavus*. Amphibia-Reptilia 28: 555-559.

Fox, W. 1955. Mating aggregations of garter snakes. Herpetologica 11: 176.

Friesen, C.R., Shine, R., Krohmer, R.W. & Mason, R.T. 2013. Not just a chastity belt: the functional significance of mating plugs in garter snakes, revisited. Biological Journal of the Linnean Society 109: 893-907.

Graves, B.M., Halpern, M. & Friesen, J.L. 1991. Snake aggregation pheromones: Source and chemosensory mediation in Western Ribbon Snakes (*Thamnophis proximus*). Journal of Comparative Psychology 105: 140-144.

Greene, M.J., Stark, S.L. & Mason, R.T. 2001. Pheromone trailing behaviour of the Brown Tree Snake, *Boiga irregularis*. Journal of Chemical Ecology 27: 2193-2201.

Greenlees, M.J., Webb, J.K. & Shine, R. 2005. Led by the blind: Bandy-bandy snakes *Vermicella annulata* (Elapidae) follow blindsnake chemical trails. Copeia 2005: 184-187.

Greer, A. 1997. The Biology and Evolution of Australian Snakes. Surrey Beatty & Sons, Chipping Norton.

Hoser, R.T. 1980. Further records of aggregations of various species of Australian snakes. Herpetofauna 12(1): 16-22.

Maryan, B. 1988. Notes on reproduction in captive *Ramphotyphlops australis* (Gray). Herpetofauna 18(2): 1-2.

Rivas, J.A. & Burghardt, G.M. 2005. Snake mating systems, behaviour, and evolution: The revisionary implications of recent findings. Journal of Comparative Psychology 119: 447-454.

Scanlon, J.D. & Davidson, C.L. 1999. Spring breeding aggregation of the blindsnake *Ramphotyphlops nigrescens* (Typhlopidae). Herpetofauna 29(1): 57-58.

Shea, G.M. 2001. Spermatogenic cycle, sperm storage, and Sertoli cell size in a scolecophidian (*Ramphotyphlops nigrescens*) from Australia. Journal of Herpetology 35: 85-91.

Shine, R. & Webb, J.K. 1990. Natural history of Australian typhlopid snakes. Journal of Herpetology 24: 357-363.

Webb, J.K. & Shine, R. 1992. To find an ant: trail-following in Australian blindsnakes (Typhlopidae). Animal Behaviour 43: 941-948.

Whittier, J.M., Mason, R.T. & Crews, D. 1985. Mating in the Red-sided Garter Snake, *Thamnophis sirtalis parietalis*: differential effects of male and female sexual behaviour. Behavioural Ecology and Sociobiology 16: 257-261.

AN OBSERVATION OF INTERSPECIFIC AMPLEXUS BETWEEN *CRINIA SIGNIFERA* (MYOBATRACHIDAE) AND *LITORIA NUDIDIGITA* (HYLIDAE)

Aaron Payne
Faculty of Education and Social Work,
University of Sydney, NSW, 2006.
Email: apay6905@uni.sydney.edu.au

INTRODUCTION

Reproduction for anurans can be an energy-intensive activity, which may expose individuals to particular risks (Bowcock *et al.*, 2009). Whilst calling by male frogs is an energy intensive activity, the energy costs of amplexus also can be significant as amplexus can last for several hours or days in some species and requires a constant application of force on the part of the male (McLister, 2003). Consequently, amplexus between different species of frogs is largely a wasteful activity with little benefit particularly when the purpose is to produce viable offspring. Temporal and spatial partitioning between similar species serves to reduce interspecific amplexus however these partitions may be less effective at certain times of the year.

Crinia signifera is a small and variable myobatrachid frog of south-east Australia where its often cosmopolitan habits make use of ephemeral and permanent water in both natural and disturbed environments (Barker et al., 1995). *Litoria nudidigita* by contrast, is a small hylid frog distributed south of Sydney to the Victorian Gippsland where it primarily inhabits pools and backwaters of streams but occasionally occurs in ponds (Anstis, 2013; Griffiths, 2006). *Crinia signifera* calls year round from the ground around the margins of the water while *L. nudidigita* calls from spring to autumn from elevated positions on vegetation or debris, adjacent to or within the water body (Anstis, 2013).

Figure 1. Interspecific amplexus between *Crinia signifera* and *Litoria nudidigita*, Telegraph Creek, Booderee National Park.

OBSERVATIONS

On 23 August 2014 an opportunistic search was conducted along Telegraph Creek in Booderee National Park approximately 30 km south east of Nowra on the New South Wales south coast. The nearby Jervis Bay (Point Perpendicular) weather station recorded 18 mm of rain for that day with several small pools forming in exposed bedrock adjacent to the creek. The surrounding vegetation consisted of a mixture of plants including *Banksia ericifolia, Gahnia clarkei* and *Lomandra longifolia*.

Several male *C. signifera* were observed calling from these pools and two *L. nudidigita* were observed in around one of the larger pools. No *L. nudidigita* were heard calling. A closer inspection revealed a male *C. signifera* in inguinal amplexus with a male *L. nudidigita* beneath a small rock ledge (Figure 1). The pair remained motionless with neither frog appearing to make any move to disengage from amplexus.

DISCUSSION

Observations of interspecific amplexus in Australian anurans have been recorded, including *Litoria cooloolensis* with *L. olongburensis* and *L. rubella* (Lowe & Hero, 2011). Additionally there are photographs in published works of *L. wilcoxi/jungguy* and *L. nannotis* (Anstis, 2013: 253), and *Limnodynastes terraereginae* and *Cyclorana brevipes* (Vanderduys, 2012: 91). In these cases of amplexus, the interactions were between species that occupied the same breeding habitats or had some degree of morphological similarity. One example of amplexus involving morphologically distinct species is a photograph of *Litoria nasuta* amplecting a *Notaden melanoscaphus* (Tyler, 2000: 62).

During the observation period, *L. nudidigita* were observed moving from crevices in the exposed rocky sections of the stream, which may have been winter refugia and in the process came into contact with calling male *C. signifera*. The activity by *L. nudidigita* in late winter was unusual but was likely to have been facilitated by the mild temperatures and recent rainfall. The observation of interspecific amplexus in *C. signifera* and *L. nudidigita* is interesting because it involves two species which are morphologically and taxonomically distinct and utilise different sites for calling and breeding. In addition to both species being members of different families, the mode of amplexus is also different with *L. nudidigita* performing axillary amplexus whereas *C. signifera* performs inguinal amplexus.

ACKNOWLEDGMENTS

I wish to thank Jordan Mulder for assistance in the field and locating the pair that provided the basis for these observations. Thanks also to Marion Anstis and Frank Lemckert for comments on the original manuscript.

REFERENCES

Anstis, M. 2013. Tadpoles and Frogs of Australia. New Holland Publishers, Sydney.

Barker, J., Grigg, G.C. & Tyler, M.J. 1995. A Field Guide to Australian Frogs. Surrey Beatty & Sons, Sydney.

Bowcock, H., Brown, G.P. & Shine, R. 2009. Beastly bondage: the costs of amplexus in Cane Toads (*Bufo marinus*). Copeia 2009: 29-36.

Griffiths, K. 2006. Frogs and Reptiles of the Sydney Region. Reed New Holland, Sydney.

Lowe, K. & Hero, J.M. 2011. *Litoria cooloolensis*: amplexus. Herpetological Review 42: 585-586.

McLister, J.D. 2003. The metabolic cost of amplexus in the Grey Tree Frog (*Hyla versicolor*): assessing the energetics of male mating success. Canadian Journal of Zoology 81: 388-394.

Tyler, M.J. 2000. Australian Frogs: a natural history. Reed New Holland, Sydney.

Vanderduys, E. 2012. Field Guide to the Frogs of Queensland. CSIRO Publishing, Collingwood.

HETEROSPECIFIC COPROPHAGY IN AN EASTERN WATER DRAGON, *INTELLAGAMA LESUEURII LESUEURII* (GRAY 1831)

James Baxter-Gilbert
Department of Biological Sciences, Macquarie University, Sydney, NSW 2109.
email: james.baxter-gilbert@students.mq.edu.au

INTRODUCTION

Australian Water Dragons (*Intellagama lesueurii*) are large agamid lizards (SVL = up to 245 mm) common along the eastern coast of Australia ranging from Cooktown, Qld, to Gippsland, Vic (Wilson & Swan, 2013). In captivity this species consumes a wide variety of food items including fish, fruit, insects, processed pet foods, rodents, snails, vegetables, and yabbies (Hosking, 2010). In the wild these lizards eat a similarly wide variety of different plants and animals, and this may enable them to persist in urban areas (Shea, 2010). Previously documented prey items include crustaceans, Delicate Skinks (*Lampropholis delicata*), Mosquitofish (*Gambusia* sp.), molluscs, Eastern Water Skinks (*Eulamprus quoyii*), and a variety of insects and scorpions (Anonymous, 1976; Greer, 1990; Wilson & Knowles, 1992; Meeks *et al.*, 2001; JBG, pers. obs.). Other food items include algae, flowers, seaweed, figs, lilypillies and other fruits (Mackay, 1959; Clifford & Hamley, 1982; Greer, 1990; Ehmann, 1992). Here, I report a novel food source, based on a single individual lizard living in an isolated urban population in the city of Sydney, NSW.

OBSERVATION

On 22 March 2016 at 1245 hrs, I observed an sub-adult male Eastern Water Dragon (SVL = 152 mm; Figure 1) eating bird faeces at the Chinese Garden of Friendship located in Darling Harbour, Sydney, NSW. The bird dropping was located underneath a tree used for roosting by Australian White Ibis (*Threskiornis molucca*), and it is within reason to assume the faeces belong to this species.

As far as I could tell, the lizard was focused on eating only the faecal material and avoided consuming the urates (Figure 2). Although sunny, the air temperature (1 m above ground) at the time of the observation was 18°C, and very few adult Eastern Water Dragons were active; however juveniles and sub-adults were numerous.

DISCUSSION

Juvenile Eastern Water Dragons are thought to be exclusively insectivorous, with plant matter increasing in their diet as they age (Hosking, 2010). The diets of adult Eastern Water Dragons are thought to be comprised of about 50% plant matter (Hosking, 2010), falling within the norm for omnivorous agamids (averaging 16.88% and ranging from 0.8-100.0%; Cooper & Vitt, 2002). Factors such as intestinal length and the reliance on gut symbionts (i.e., bacteria and protozoa) to breakdown cellulose have been suggested as possible reasons for the observed shift seen in some lizard species from insectivorous diets as juveniles to more omnivorous diets as adults (Cooper & Vitt, 2002). If this is the case then it could be predicted that intermediate-sized individuals may ingest conspecific faecal material as a means of both ingesting partially digested plant material, but also as a means of gathering important gut microbes required for digestion. This behaviour has been documented in African Elephants (*Loxodonta africana*; Leggett, 2004), Koala (*Phascolarctos cinereus*; Osawa et al., 1993), domestic horses (*Equus caballus*; Crowell-Davis et al., 1989), group-living cockroaches and eusocial termites (Weiss, 2006), and in some iguanid species (e.g., *Amblyrhynchus cristatus*, *Cyclura carinata*, and *Iguana iguana*; Iverson, 1980; Troyer, 1982; Kelley, 2008). However, since this observation was of an

individual lizard eating the faeces of a bird species with a diet presumably consisting of aquatic and terrestrial invertebrates (Carrick, 1959), or human food scraps and refuse (Martin *et al.*, 2007), it is unlikely that this feeding behaviour is related to the ontogenetic change from insectivory to omnivory or the collection of beneficial gut microbes for the digestion of plant material. Rather, I suggest that this is merely an opportunistic instance of a lizard with a highly variable diet taking advantage of a readily available food source; albeit the nutritional value of faeces is likely relatively poor but might come at no cost. There are several instances of lizards engaging in heterospecific coprophagy, including Indian Spiny-tailed Lizards (*Saara hardwickii*) feeding on fresh cow dung (Ramesh &

Figure 1. A sub-adult male Eastern Water Dragon captured after feeding on Australian White Ibis faeces.

Sankaran, 2013) and Bobtail Lizards (*Tiliqua rugosa*) feeding on domestic dog faeces (Wolfe *et al.*, 2015). However, to the best of my knowledge this is the first documented case of a lizard feeding on bird faeces, as well as the first documented case of coprophagy for this species.

ACKNOWLEDGMENTS

I would like to thank Dr Martin Whiting and Dr Glenn Shea for their assistance in preparing this manuscript, and the two anonymous reviewers for their helpful recommendations, insights, and comments. This observation was made during field research on urban populations of Eastern Water Dragons in accordance with Macquarie University Animal Ethics Committee (AEC Ref. No.: 2015/023-4) and under a scientific licence (SL100570) from the New South Wales National Parks and Wildlife Service.

REFERENCES

Anonymous 1976. Observations on the Eastern Water Dragon *Physignathus lesueurii* in the natural state and in captivity. Herpetofauna 8(2): 20-22.

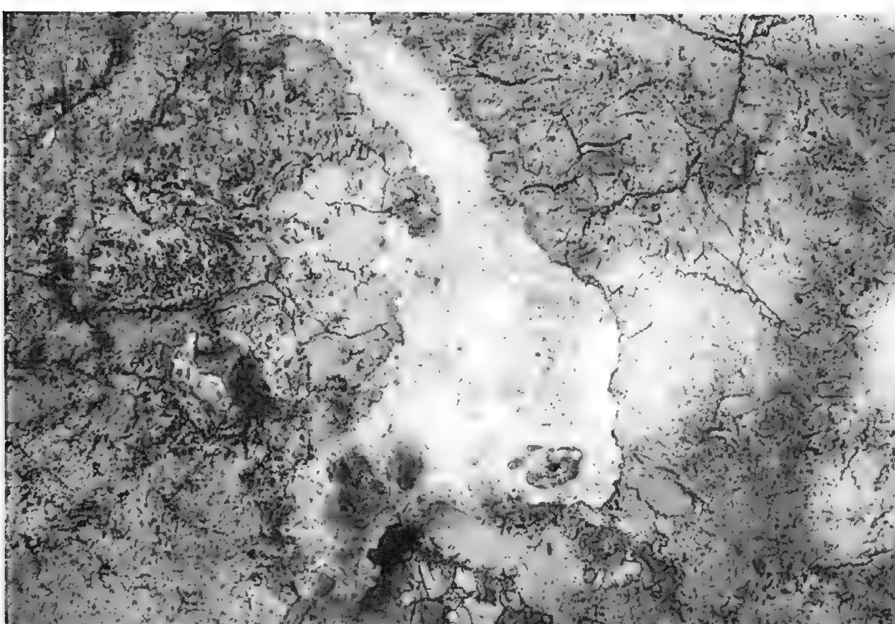
Carrick, R. 1959. The food and feeding habits of the Straw-necked Ibis, *Threskiornis spinicollis* (Jameson), and the White Ibis, *T. molucca* (Cuvier) in Australia. Wildlife Research 4: 69-92.

Clifford, H.T. & Hamley, T. 1982. Seed dispersal by Water Dragons. Queensland Naturalist 23(5-6): 49.

Cooper, W.E. & Vitt, L.J. 2002. Distribution, extent, and evolution of plant consumption by lizards. Journal of Zoology 257: 487-517.

Davis, S.L. & Caudle, A.B. 1989. Coprophagy by foals: recognition of mater-

Figure 2. The droppings from an Australian White Ibis with most of the faecal material consumed (note the remaining material in the bottom left bearing bite marks), and to the left of the main dropping a section that was dropped during the capture of the Eastern Water Dragon.



nal feces. Applied Animal Behaviour Science 24: 267-272.

Ehmann, H. 1992. Encyclopaedia of Australian Animals: Reptiles. Angus & Robertson, Pymble.

Greer, A.E. 1990. The Biology and Evolution of Australian Lizards. Surrey Beatty & Sons, Chipping Norton.

Hosking, C. 2010. Husbandry Guidelines for Australian Water Dragon, *Physignathus lesueurii* (Reptilia: Agamidae). Australian Museum. Available online. http://www.australianmuseum.net.au/uploads/documents/25515/water%20dragon%20husbandry%20guidelines%20chris%20hosking.pdf

Iverson, J.B. 1980. Colic modifications in iguanine lizards. Journal of Morphology 163: 79-93.

Kelley, T. 2008. PCR-DDGE comparison of fecal bacteria from captive and wild populations of the endangered San Esteban Island Chuckwalla (*Sauromalus varius*). Masters Thesis. Western Kentucky University.

Leggett, K. 2004. Coprophagy and unusual thermoregulatory behaviour in desert-dwelling elephants of north-western Namibia. Pachyderm 36: 113-115.

Mackay, R. 1959. Reptiles of Lion Island, New South Wales. Australian Zoologist 12: 308-309.

Martin, J.M., French, K. & Major, R.E. 2007. The pest status of Australian White Ibis (*Threskiornis molucca*) in urban situations and the effectiveness of egg-oil in reproductive control. Wildlife Research 34: 319-324.

Meek, R., Avery, R. & Weir, E. 2001. *Physignathus lesueurii* (Australian Water Dragon): predation on a skink, *Lampropholis delicata*. Herpetological Bulletin 76: 31-32.

Osawa, R., Blanshard, W.H. & Ocallaghan, P.G. 1993. Microbiological studies of the intestinal microflora of the Koala, *Phascolarctos cinereus*. 2. Pap, a special maternal feces consumed by juvenile koalas. Australian Journal of Zoology 41: 611-620.

Ramesh, M., & Sankaran, R. 2013. Natural history observations on the Indian Spiny-tailed Lizard *Uromastyx hardwickii* in the Thar Desert. Pp. 295-310 in, Sharma, B.K., Kulshreshtha, S. & Rahmani, A.R. (eds.). Faunal Heritage of Rajasthan, India. Springer, New York.

Shea, G.M. 2010. The suburban terrestrial reptile fauna of Sydney – winners and losers. Pp. 154-197 in, Lunney, D., Hutchings, P. & Hochuli, D. (eds.). The Natural History of Sydney. Royal Zoological Society of NSW, Mosman.

Troyer, K. 1982. Transfer of fermentative microbes between generations in a herbivorous lizard. Science 216: 540-542.

Weiss, M.R. 2006. Defecation behavior and ecology of insects. Annual Review of Entomology 51: 635-661.

Wilson, S.K. & Knowles, D.G. 1992. Australia's Reptiles, a Photographic Reference to the Terrestrial Reptiles of Australia. Angus & Robertson, Pymble.

Wilson, S. & Swan, G. 2013. A Complete Guide to Reptiles of Australia. Fourth Edition. New Holland, Sydney.

Wolfe, A.K., Bateman, P.W. & Fleming, P.A. 2015. Vehicles, pet predators, and diseases, oh my! Causes of reptile death in a city using volunteer records from wildlife rehabilitation centres. Platform Presentation presented at the 2015 International Ethological Congress, Cairns, Queensland.

A RECORD OF THE INDO-PACIFIC GECKO *HEMIDACTYLUS GARNOTII* (DUMÉRIL AND BIBRON)(GEKKONIDAE) FROM SYDNEY, NEW SOUTH WALES

Kieran D. Boylan,
50 Quinlan Parade, Manly Vale, NSW 2093.
Email: kieran.boylan33@gmail.com

The Indo-Pacific or Fox Gecko, *Hemidactylus garnotii*, is one of two species of the genus that occurs widely in Pacific Oceania, both of which are invasive species that have established populations on a number of island groups (Zug, 1991; Moritz *et al.*, 1993; Kraus, 2009). The other species, *H. frenatus*, has long been established in tropical Australia (Wilson & Swan, 2008; Hoskin, 2011), and is gradually moving south along the New South Wales coastal plain from Queensland (Lloyd, 2000; Hollis, 2006; Lemckert, 2007).

To date, *Hemidactylus garnotii* has not been recorded from the Australian mainland, with the only records being two individuals collected in 2011 and 2012 from Barrow Island (Western Australian Museum R172506, R172563; Atlas of Living Australia, www.ala.org.au).

In early 2015, a gecko was sighted in the bathroom of my residence in Manly Vale, which did not closely resemble any Australian gecko known to me. I observed what I presumed to be the same individual several times over the following year. On 11 January 2016, the gecko was captured by a visitor to the house, and was at first thought to be *Hemidactylus frenatus*. However, it was subsequently identified as *Hemidactylus garnotii* by Glenn Shea and Jodi Rowley at the Australian Museum. The individual (Australian Museum R185620; Figures 1-3) had a snout-to-vent length of 51 mm, a total length of 113 mm, and a mass of 2.1 g. It was identified as *H. garnotii* by the combination of the second pair of enlarged postmental scales being separated from the infralabials by small scales (*vs* contacting the infralabials in *H. frenatus*), undivided lamellae under the base of the fourth toe (*vs* paired), a greater number of lamellae under the fourth toe (11-14 *vs* 9-10), with the enlarged lamellae extending onto the sole of the foot (*vs* to the base of the digit), and a flattened tail with a row of ventrolateral spines (*vs* rounded, with both lateral and dorsolateral rows of spines), and the tail much longer than the body length (Kluge & Eckardt, 1969; Bauer & Sadlier, 2000; Morrison, 2003).

Since the collection of this specimen, there have been three sightings of single adults and one sighting of a dead juvenile within my residence. The most recently observed adult was a gravid female with two eggs visible through the body wall. This individual escaped after being caught.

Figure 1. *Hemidactylus garnotii* from Manly Vale, Sydney.

Hemidactylus garnotii is a known parthenogenetic species, with females producing two eggs in a clutch without the involvement of a male (Kluge & Eckardt, 1969; Zug, 1991; Cox *et al.*, 1999). Hence, the subsequent individuals observed are likely to represent local breeding rather than accidental importation of multiple individuals or eggs in one event. While *H. garnotii* becomes displaced by *H. frenatus* where the two species come into contact, *H. garnotii* readily moves from being a human commensal to adjacent forest and woodland habitats, unlike most introduced populations of *H. frenatus* (Hunsacker

Figure 2. Throat of *Hemidactylus garnotii* from Manly Vale, Sydney, showing second pair of chin shields separated from infralabials scales.

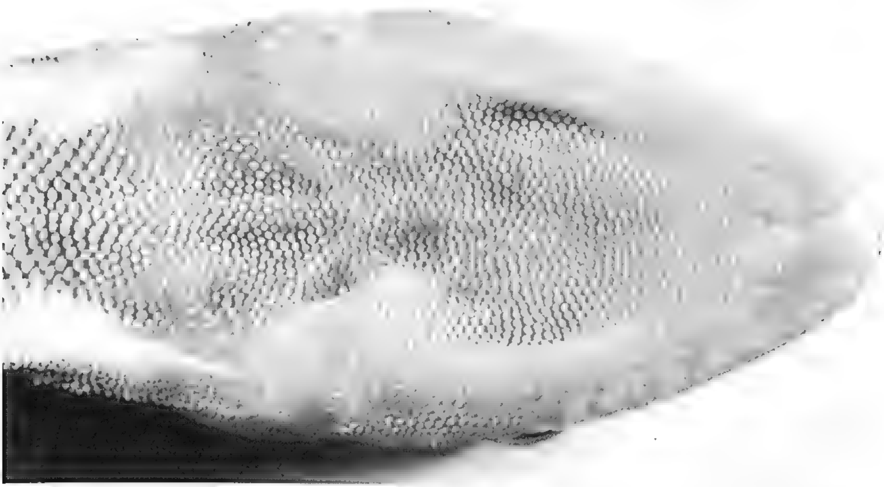


Figure 3. Underside of tail and foot of *Hemidactylus garnotii* from Manly Vale, Sydney, showing ventrolateral row of spinous scales on tail, and 13 lamellae under fourth toe, with basal lamellae undivided.

& Breese, 1969; Petren et *al.*, 1993; Bauer & Sadlier, 2000) although there is some evidence of *H. frenatus* in tropical Australia occurring short distances (up to 1 km) from human settlement (Hoskin, 2011). With the combination of parthenogenesis and an ability to spread into a range of habitats, it is possible that the geckos seen in my residence, within close proximity to both suburban development and bushland, may be part of a more extensive local population, although I have not attempted to search other local sites.

In the absence of other local arboreal geckos in the Sydney region, other than the usually rock-dwelling *Phyllurus platurus*, the establishment of *H. garnotii* may not have significant local ecological effects even if it has spread into adjacent forest and woodlands, although it is not known whether the species will extensively utilise rock outcrops. However, with the similarity of *H. garnotii* and *H. frenatus*, and the gradual southwards movement of *H. frenatus* towards Sydney, it is important to verify any future *Hemidactylus* records with voucher specimens. The potential for contact between the two species in the Sydney region in the future also provides a model for studies of their interaction.

ACKNOWLEDGMENTS

I thank Terry Boylan and Michael McFadden of Taronga Zoo, and Jodi Rowley and Glenn Shea at the Australian Museum for assistance with identification of the gecko, and Azrielle de Vor for capturing it.

REFERENCES

Bauer, A.M. & Sadlier, R.A. 2000. The herpetofauna of New Caledonia. Society for the Study of Amphibians and Reptiles, Ithaca.

Cox, M.J., Dijk, P.P., Nabhitabhata, J. & Thirakhupt, K. 1999. A photographic guide to snakes and other reptiles of Peninsula Malaysia, Singapore and Thailand. New Holland, Sydney.

Hollis, G. 2006. A range extension for the Asian House Gecko *Hemidactylus frenatus*: a record from Coffs Harbour, New South Wales. Herpetofauna 36: 31-32.

Hoskin, C.J. 2011. The invasion and potential impact of the Asian House Gecko (*Hemidactylus frenatus*) in Australia. Austral Ecology 36: 240-251.

Hunsacker, D. & Breese, P. 1967. Herpetofauna of the Hawaiian Islands. Pacific Science 21: 423-428.

Kluge, A.G. & Eckardt, M.J. 1969. *Hemidactylus garnotii* Duméril and Bibron, a triploid all-female species of gekkonid lizard. Copeia 1969: 651-664.

Kraus, F. 2009. Alien reptiles and amphibians. A scientific compendium and analysis. Springer.

Lemckert, F. 2007. A record of the Asian House Gecko at Bulahdelah. Herpetofauna 37: 108.

Lloyd, G. 2000. It's a small world. Herpetofauna 30(2): 34-35.

Moritz, C., Case, T.J., Bolger, D.T. & Donnellan, S. 1993. Genetic diversity and the history of Pacific island house geckos (*Hemidactylus* and *Lepidodactylus*). Biological Journal of the Linnean Society 48: 113-133.

Morrison, C. 2003. A field guide to the herpetofauna of Fiji. University of the South Pacific, Suva.

Petren, K., Bolger, D.T. & Case, T.J. 1993. Mechanisms in the competitive success of an invading sexual gecko over an asexual native. Science 259: 354-358.

Wilson, S. & Swan, G. 2008. A complete guide to reptiles of Australia. New Holland, Sydney.

Zug, G.R. 1991. Lizards of Fiji: natural history and systematics. Bishop Museum Bulletin in Zoology 2: i-xii + 1-136.

AMALOSIA JACOVAE, AN ADDITION TO THE HERPETOFAUNA OF NEW SOUTH WALES

Matthew J. Greenlees & Chalene Bezzina
School of Biological Sciences, The University of Sydney, NSW 2006.

The Clouded Gecko, *Amalosia jacovae* (Couper, Keim & Hoskin, 2007) is a small, slender arboreal species that inhabits dry open eucalypt woodland, heath and rock outcrops in temperate, near coastal regions of southeast Queensland (Wilson & Swan, 2014). The species is most closely related to *A. rhombifer* (Duméril & Bibron, 1839) and *A. lesueurii* (Gray, 1845) but is genetically divergent from both and diagnosed by its dorsal pattern, the shape of the first and second supralabial scales and in having well-developed webbing between the third and fourth toes (Couper *et al.*, 2007). Herein, we report a new record of this species, extending its distribution from southeast Queensland into northern NSW.

On 27 February 2014, at approximately 2100hrs, we were driving along a road bisecting state forest and rural pastoral land, approximately 5 km southeast of Grafton in northeastern NSW. While travelling at 20 km/hr, casually spotlighting with head-torches through open windows we spotted the movement and eye-shine of a gecko on the trunk of a large (80 cm dbh) Spotted Gum Tree (*Corymbia maculata*). The gecko was approximately 1.8 m above ground, at a distance of approximately 10 metres from the

Figure 1. The gecko as found, on the trunk of a Spotted Gum Tree, *C. maculata*. Note well-developed webbing between 3rd and 4th toe.

road. The habitat was dry open Eucalypt woodland, dominated almost exclusively by the same tree species (C. *maculata*), and with a very sparse understory.

We did not recognise the gecko as a species occurring in the area, so we captured it and took photographs of what we considered to be its diagnostic features (Figures 1-2). After this brief disturbance, the gecko was released at its capture site. We subsequently determined its identity as a Clouded Gecko, *Amalosia jacovae*, distinguished from its closest congeners by having pronounced basal webbing between the third and fourth toes, a distinctive dorsal pattern, and lacking distinct pale blotches on the snout, flanks and limbs (Figures 1-2) (diagnostic characters for this species, Couper *et al.*, 2007: Wilson & Swan, 2014).

To our knowledge, this is the first record of this species in New South Wales. There are 44 records from Queensland and some of these are 50 km from the Qld / NSW border (ALA, 2015) (Figure 3). That this species occurs in northern NSW is not surprising. However, our record is approximately 150 km southeast of the nearest Queensland record, suggesting a range extending some distance into NSW.

Figure 2. Head of gecko. Note the lack of distinct spotting on the face and arm, distinguishing the individual from the closely related *A. lesueurii*.

Figure 3. Distribution map showing the Grafton record (star) in relation to other *A. jacovae* records (open circles)

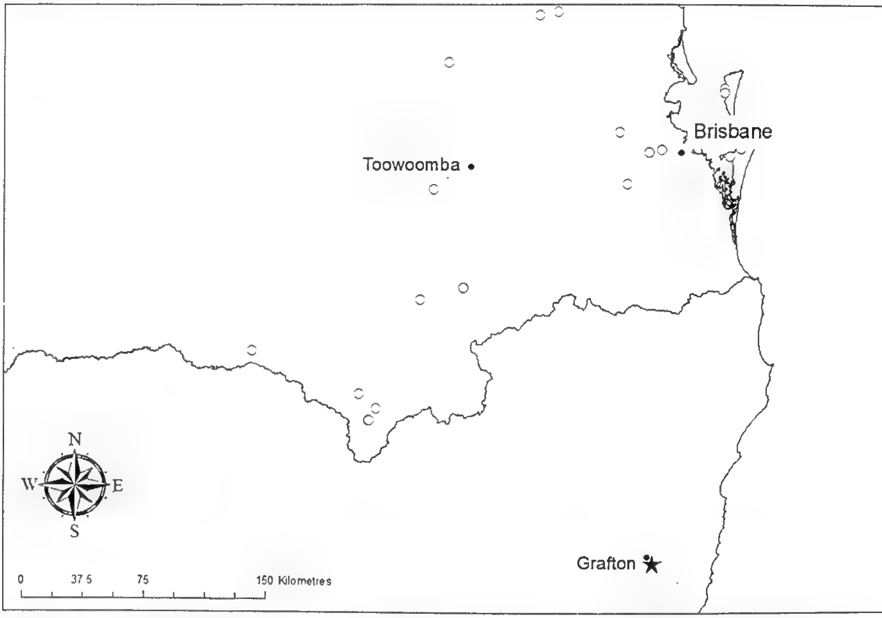
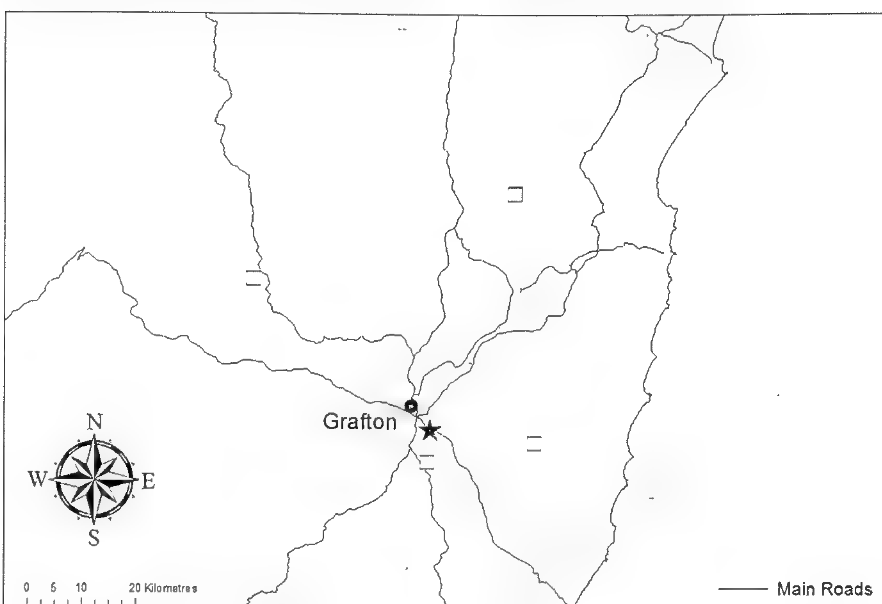


Figure 4. The Grafton *A. jacovae* record (star) and proximal, putative records of *A lesueurii* within the Clarence Valley (open squares). Lines indicate the location of major roads.



It is possible that this species may occur continuously from the Grafton area and north through the Clarence Valley, linking this population with the known Qld range; and additionally, further south. There are 5 other records of the closely related *Amalosia lesueurii* within the Clarence Valley Local Government Area, all within 50 km of this record (Figure 4).

A molecular study of *A. lesueurii* examining patterns of diversity associated with biogeographic history only included samples from as far north as the upper Hunter Valley (Dubey *et al.*, 2012), approximately 300 km south of this record. As there are over 100 records of '*A. lesueurii*' between the most northerly-occurring individual sampled in that study and the Qld border (ALA, 2015). It should therefore be considered that at least some of these records may refer to *A. jacovae*.

It is difficult to speculate on the conservation status of *A. jacovae* in NSW. The identity of this NSW population should be assessed genetically and its broader distribution determined by further survey work; initially, in areas proximate to this record and with comparable vegetation communities, habitat structure and climate.

ACKNOWLEDGMENTS

This observation made while conducting research under University of Sydney Animal Ethics protocol L04/1-2011/3/5446, NSW NPWS permit SL100611. We thank S. McDonald and C. Hoskin for assistance with confirmation of the identity, M. Crowther for assisting with the preparation of maps, and P. Couper (especially) and an anonymous reviewer for comments that improved the manuscript. All photographs ©Matthew Greenlees.

REFERENCES

ALA 2015. The Atlas of Living Australia. www.ala.org.au. Accessed 9 April 2015.

Couper, P.J., Keim, L.D. & Hoskin, C.J. 2007. A new Velvet Gecko (Gekkonidae: *Oedura*) from south-east Queensland, Australia. Zootaxa 1587: 27-41.

Dubey, S., Croak, B. Pike, D., Webb, J. & Shine, R. 2012. Phylogeography and dispersal in the velvet gecko (*Oedura lesueurii*), and the potential implications for conservation of an endangered snake (*Hoplocephalus bungaroides*). BMC Evolutionary Biology 12: 67.

Duméril, A.M.C. & Bibron, G. 1839. Erpétologie générale ou histoire naturelle complete des reptilés. Volume 3. Roret, Paris.

Gray, J.E. 1845. Catalogue of the specimens of Lizards in the Collection of the British Museum. Newman, London.

Wilson, S. & Swan, G. 2013. A Complete Guide to Reptiles of Australia. Fourth Edition. New Holland Publishers. Sydney.

A POSSIBLE PREDATION EVENT OF A STIMSON'S PYTHON (*ANTARESIA STIMSONI*) BY AN OLIVE PYTHON (*LIASIS OLIVACEUS OLIVACEUS*) (SERPENTES: PYTHONIDAE) IN NORTH-WEST QUEENSLAND

Kurtis John-Scott Lindsay
Narla Environmental Pty Ltd, PO Box 406, Mona Vale, NSW, 1660.
Email: kurtis.lindsay@narla.com.au

INTRODUCTION

The Olive Python (*Liasis olivaceus*) is known to consume a wide diversity of vertebrate prey. A comprehensive literature review of biology of the Australasian pythons listed prey items of all known species including the Olive Python (Shine & Slip, 1990). The most commonly reported prey items were mammals including rats, followed by birds, then reptiles including agamids, scincids and to a lesser extent snakes (with one record). Many species of snake are known to practice ophiophagy, consumption of other snakes, as a component of the normal diet (Greene, 1997). Trembath (2008) provided a summary of examples in the literature of ophiophagy in the Australopapuan python radiation and noted three records of ophiophagy by Olive Pythons (Shine & Slip, 1990; Kend, 1997; O'Shea, 2007). Weigel (2007) reported a fourth potential instance. Since then no further records of ophiophagy or attempted ophiophagy by Australian pythons have been reported in the literature.

Here I report a further instance of attempted ophiophagy by an Olive Python in the wild.

OBSERVATIONS

On 10 February 2013 at around 0800 hrs, I observed two Olive Python predation events at a small freshwater, spring-fed waterhole in the North-east Knapdale Range (20°12'S 140°08'E), north of Cloncurry, Queensland. Weather conditions were sunny with no cloud cover and an ambient temperature of 30°C. The waterhole was formed in a sheltered gully incised into bedrock. The limited vegetation canopy was dominated by Ghost Gum (*Corymbia* spp.) and Arid Peach (*Terminalia aridicola*). Large numbers of pigeons (Columbidae), honeyeaters (Meliphagidae) and parrots (Psittacidae) were observed to drink at the waterhole during the few days before the reported observation took place, as were mammals including the Common Wallaroo (*Macropus robustus*). Multiple sloughs and scats belonging to reptiles including pythons were found around the waterhole, with a concentration in and around a deep crack in the rock where one or more Olive Pythons may have sheltered.

I first noticed a large (estimated 2 m snout-vent length) adult Olive Python partially submerged in the waterhole and feeding on a Peaceful Dove (*Geopelia placida*), which it had recently captured. The snake then fully submerged itself, and re-emerged only its head and anterior body. It then swam across the waterhole with its head protruding above the surface, while swallowing the last feathers of its prey. The snake was closely observed and photographs were taken. This snake did not appear to react in any way to my presence and continued as it was when I first saw it.

A second Olive Python (estimated 1.5 m snout-vent length) was present no more than 3 metres away, and was coiled up as if it was also feeding.

The two Olive Pythons showed no signs that they were aware of each other's presence and did not interact during the observation. On close inspection of the smaller Olive Python, it was found to be grasping a smaller snake, which I identified as an adult Stimson's Python (*Antaresia stimsoni*). When first observed, the Olive Python had the Stimson's Python in the grasp of its coils (Figures 1-2), but was not

Figure 1. Olive Python coiled around Stimson's Python, as first observed.

Figure 2. At first observation, only the posterior body of the Stimson's Python was being constricted.

Figure 3. Olive Python changing to full feeding grip.

Figure 4. Olive Python biting posterior body of Stimson's Python.

consuming it, as despite their bodies being fully intertwined, both snakes' heads were visible. The head and anterior body of the Stimson's Python was moving quickly, apparently seeking to escape the grasp of the Olive Python. It then buried its head into the leaf litter and stopped moving.

The Olive Python rapidly coiled around the Stimson's Python in a full feeding position (Figure 3) and latched its jaws around the smaller snake's posterior body. The Olive Python's jaws could not fully grasp the Stimson's Python owing to the obstruction of a large twig (Figure 4). The Stimson's Python repeatedly moved its head and fore body rapidly in the opposite direction with intermittent pauses. The Olive Python did not move its head or fore body any more although it did appear to tighten its coils around the body of the Stimson's Python. Photographs and videos were taken throughout this time. Unfortunately I could not stay to observe the interaction any further; as such I am not aware if the Olive Python was able to consume the Stimson's Python.

DISCUSSION

This is not the first instance of ophiophagy by Olive Python in the wild in Australia; however there have been no previous photographs of such an event that I am aware of. Australian pythons other than the *Aspidites* spp. are not known to commonly consume other snakes (Slip & Shine, 1990; Trembath, 2008), and this observation appears to be only the second record in the Australian literature of attempted ophiophagy by Olive Python on another python species in the wild. The previous account involved an Olive Python constricting a Rough-scaled Python (*Morelia carinata*) (Weigel, 2007).

The other Olive Python at the waterhole was feeding on a small dove common to the area. It is expected that birds such as this are a more common component of the Olive Python diet than other snakes (Slip & Shine, 1990).

Most of our knowledge of python foraging behaviour is derived from observations of these species in captivity. Observations such as the one reported in this publication contribute to our understanding of Australian python ecology and biology and similar observations should be published in the literature so as to shed more light on the ecology of Australian reptiles outside of captivity.

Further images and videos can be provided upon request to the author.

REFERENCES

Greene, H.W. 1997. Snakes: The Evolution of Mystery in Nature. University of California Press, Los Angeles.

Kend, B. 1997. Pythons of Australia. Canyonlands Publishing Group, Provo.

Shine, R. & Slip, D.J. 1990. Biological aspects of the adaptive radiation of Australian pythons (Serpentes: Boidae). Herpetologica 46: 283-290.

Trembath, D. 2008. A record of ophiophagy by the Spotted Python *Antaresia maculosa* (Serpentes: Pythonidae) from Murray Falls National Park, North Queensland, Australia. Herpetofauna 38: 82-83.

Weigel, J. 2007. Rough-scaled Python *Morelia carinata* (Smith, 1981). Pp. 183-195 in, Swan, M. (ed.). Keeping and Breeding Australian Pythons. Mike Swan Herp Books, Lilydale.

PREDATION ON A WEASEL SKINK (*SAPROSCINCUS MUSTELINUS*) (SQUAMATA: SCINCIDAE: LYGOSOMINAE) BY A REDBACK SPIDER (*LATRODECTUS HASSELTI*) (ARANEAE: ARANEOMORPHA: THERIDIIDAE), WITH A REVIEW OF OTHER *LATRODECTUS* PREDATION EVENTS INVOLVING SQUAMATES

Mark O'Shea[1,3] and Kathryn Kelly[2]
[1]Faculty of Science and Engineering, University of Wolverhampton, Wulfruna Street, Wolverhampton, WV1 1LY, United Kingdom, and
West Midland Safari Park, Bewdley, Worcestershire, DY12 1LF, United Kingdom.
[2]5 Moor Street, East Bentleigh, Victoria 3165, Australia.
[3]Email: oshea@markoshea.info

Small vertebrates occasionally fall victim to large or venomous invertebrates, one of the most frequently reported scenarios being that of a small lizard predated by a venomous arachnid (Bauer, 1990). The Redback Spider, *Latrodectus hasselti* Thorell, 1870, is an indigenous Australasian species belonging to the cosmopolitan genus *Latrodectus* Walckenaer, 1805, which also includes the black widow spiders of Europe (*L. tredecimguttatus* (Rossi, 1790); *L. lilianae* Melic, 2000); the widow spiders of North America (*L. mactans* (Fabricius, 1775); *L. hesperus* Chamberlin & Ivie, 1935; *L. bishopi* Kaston, 1838; *L. variolus* Walckenaer, 1837); the button spiders of Africa (*L. cinctus* Blackwall, 1865; *L. indistinctus* Cambridge, 1904; *L. karooensis* Smithers, 1944; *L. rhodesiensis* Mackay, 1872; *L. geometricus* Koch, 1841), and the endangered katipo spider (*L. katipo* Powell, 1871) of New Zealand (World Spider Catalogue, 2016).

Distributed throughout Australia, including Tasmania and many offshore islands, *L. hasselti* is also known from New Caledonia, and has been introduced into Japan, and New Zealand (Vink *et al.*, 2011), where it is feared to pose a threat to *L. katipo*, through inbreeding and displacement. *Latrodectus hasselti* is found in diverse habitats, from tropical forest to desert, where it inhabits dry, dark, and protected places, e.g., rock crevices, dead wood, and shrubs. It is especially common in anthropogenic environments. Female *L. hasselti* may achieve 14 mm in body length and possess a distinctive, eponymous red stripe on the dorsal surface of the bulbous black abdomen and red hourglass on its ventral side, while males rarely exceed 3 mm (Brunet, 1994). Adult female *L. hasselti* possess a highly neurotoxic venom containing the presynaptic neurotoxin α-latrotoxin, which specifically targets vertebrates, causing considerable pain (Garb & Yaashi, 2013) and is capable of causing human fatalities, although no human deaths have been reported in Australia since the advent of antivenom in 1956 (Brunet, 1994).

Latrodectus hasselti feeds primarily on small invertebrates such as woodlice, flies, beetles, moths and cockroaches, but there are reports of it preying on larger venomous invertebrates, including centipedes (Roberts, 1941), and wandering male trapdoor and funnel-web spiders (Brunet, 1998). Vertebrates are also documented in the diet of female *L. hasselti*, and while some fishing spiders (*Dolomedes*: Pisauridae) feed on fish, fish fry, and frogs, and large orb-weaving spiders (*Nephila*: Nephilidae) occasionally trap birds, the vertebrate prey of *Latrodectus* is primarily reptilian (McCormick & Polis, 1982), although there exists a single historical record of a mouse being captured by *L. hasselti* (McKeown, 1943).

We report predation on a Weasel Skink, *Saproscincus mustelinus* (O'Shaughnessy, 1874), by a female *Latrodectus hasselti* in an urban environment in the suburbs of Melbourne, Victoria.

The scincid genus *Saproscincus* contains twelve species (Hoskin, 2013; Wilson & Swan, 2013; Cogger, 2014), distributed on the eastern seaboard of Queensland, New South Wales and Victoria. They are oviparous, diurnal, terrestrial, and shade loving, being rarely encountered far from cover, hence the commonly applied vernacular name 'shade skinks' (Cogger, 2014). The southern-most species in the genus is *S. mustelinus*, to which the vernacular name Weasel Skink is usually applied. *Saproscincus mustelinus* is a small species (SVL 45-55 mm) of the coast and ranges of eastern New South Wales and Victoria, where it inhabits wet and dry sclerophyll forest and coastal heathland, but it is also common in suburban gardens (Cogger, 2014). This small skink has many potential predators, including snakes (Webb *et al.*, 2003), birds (Anderson & Burgin, 2008), domestic cats (Dickman & Newsome, 2015), and predatory invertebrates (this paper).

The predation event was observed at 1214 hrs on Saturday 21 November 2015 by one of us (KK). The spider had constructed its web on the underside of a child's pram, which was normally stored folded in the garage at the family home in Carnegie, southeast Melbourne, but had been transported by car to a play centre in Warrigal Road, Moorabbin. Whilst the pram was at the play centre the spider was discovered in the act of biting and binding a *S. mustelinus*, although it was unclear whether the skink had been captured

Figure 1. Redback spider (*Latrodectus hasselti*) predation on a Weasel skink (*Saproscincus mustelinus*).

at the play centre, or earlier in the garage and relocated with the spider and the pram. The predation event was recorded on an iPhone 4 camera phone (Figure 1).

It is notable from the image that the spider is biting near the head, the usual target area (de Rebeira, 1981; Orange, 1989, 2007), and also that the tail has been elevated and bound to the body. It may be the case that elevation of prey items from the ground is intended to avoid the attentions of ants, which could use prey in contact with the ground to overrun the web and potentially kill the spider. Certainly observations suggest that once a dropped prey item has been scavenged by ants the spider has little chance of recovering it and will seek to avoid contact with the ants (Orange, 2007).

A literature search revealed further accounts of small Australian reptiles being predated by *L. hasselti* (Table 1). Even snakes occasionally become victims (Anonymous, 1939;

Table 1: Australian records of lizards and snakes predated by *Latrodectus hasselti*.

Taxon	Location	Source
GEKKONIDAE		
Christinus marmoratus (as *Phyllodactylus marmoratus*)	Perth, WA	Konig, 1987
Christinus marmoratus (n=2)	Hamersley, WA	Orange, 2007
Gehyra variegata	Kambalda East, WA	Orange, 2007
SCINCIDAE		
Anomalopus verreauxii	n/a	Raven 1990
Cryptoblepharus pulcher (as *C. boutonii virgatus*)	n/a	Cook, 1973
Cryptoblepharus pulcher (as *C. virgatus*) (n=2)	n/a	Raven 1990
Hemiergis quadrilineata (n=3)	Hamersley, WA	Orange, 2007
Lampropholis delicata	SW Sydney, NSW	Metcalfe & Ridgeway, 2013
Lampropholis guichenoti (as *Leiolepisma guichenoti*)	Kangaroo Valley, NSW	Copland, 1953
"*Lygosoma* sp."	Narrabeen, NSW	McKeown, 1953
Saproscincus mustelinus	Moorabbin, Vic.	this paper
unidentified skinks (n=2)	n/a	Roberts, 1941
unidentified skinks (n=2)	n/a	McKeown, 1952
ELAPIDAE		
Parasuta dwyeri	Lockhart, NSW	Durigo, 2010
Parasuta monachus (as *Rhinoplocephalus monachus*)	Kambalda East, WA	Orange, 1990
Parasuta nigriceps	Gooroc, Vic.	Malpass, 2015
Pseudonaja affinis (unsuccessful)	Helena Valley, WA	De Rebeira, 1987
"black snake"	Roma, Qld	McKeown, 1943

McKeown, 1943; de Rebeira, 1981; Orange, 1990), although given the public shock value of these encounters they are now more likely to be found on newspaper websites (Durigo, 2010; Malpass, 2015) than in peer-reviewed publications, and are therefore lacking in scientific data. Attacks by female *L. hasselti* on snakes are not always successful. A juvenile dugite (*Pseudonaja affinis*) survived almost 7.5 hours of repeated attacks in a web before being removed, kept under observation for three days, and subsequently released (de Rebeira, 1981).

By far the largest proportion of reptiles found in the webs of *L. hasselti* are small lizards, and they are probably more vulnerable to predation than snakes because, in addition to being smaller and more abundant, they are often found in the same discrete, confined corners of outbuildings, workshops, or the natural environment as *L. hasselti*. Most of these reports concern skinks (McKeown, 1936; Roberts, 1941; McKeown, 1943, 1952; Copland, 1953; Cook, 1973; Raven, 1990; Orange, 2007; Metcalfe & Ridgeway, 2013), with fewer instances of geckos as prey

Table 2: Records of lizards and snakes predated by *Latrodectus* spp. outside of Australia.

Taxon	*Latrodectus* sp.	Location	Source
GEKKONIDAE			
Tarentola mauritanica	*L. lilianae*	Granada, Spain	Hódar & Sánchez-Piñero, 2002
LACERTIDAE			
Acanthodactylus erythrurus	*L. lilianae*	Granada, Spain	Hódar & Sánchez-Piñero, 2002
Mesalina guttulata	*L. revivensis*	Negev, Israel	Zilberberg, 1988
Mesalina guttulata	*L. pallidus*	Judean Desert, Israel	Blondheim & Werner, 1989
Podarcis melisellensis fiumana	*L. tredecimguttatus*	Krk Island, Croatia	Schwammer & Daurecht, 1988
Psammodromus hispanicus (n=3)	*L. lilianae*	Granada, Spain	Hódar & Sánchez-Piñero, 2002
SCINCIDAE			
Scincella lateralis (as *Leiolopisma laterale*) (n=2)	*L. mactans*	Georgia, USA	Neill, 1948
COLUBRIDAE			
Liochlorophis vernalis (as *Opheodryas vernalis*)	*L. mactans*, probably *L. variolus*	USA	Neill, 1948
NATRICIDAE			
Storeria dekayi	*L. mactans* or *L. variolus*	USA	Neill, 1948

(König, 1987; Orange, 2007). Table 1 lists 14 skinks and four geckos predated by *L. hasselti*.

Latrodectus hasselti predation of skinks, and to a lesser degree of geckos, is probably a much more frequent occurrence than the scattered literature would suggest. Orange (2007) observed three *Hemiergis quadrilineata* (Scincidae) and two *Christinus marmoratus* (Gekkonidae) in the webs of *L. hasselti*, or as discarded remains beneath the webs. Two of the *H. quadrilineata* were captured by the same female spider over a five day period and all observations were made in the same 900 m^2 suburban garden in the outskirts of Perth, WA. Orange (2007) additionally noted that neither of the other skink taxa present in the garden, *Cryptoblepharus plagiocephalus* and *Menetia greyii*, had been observed as *L. hasselti* prey, despite all being small species, well within the capabilities of the spider. *Hemiergis* and *Menetia* are terrestrial while *Cryptoblepharus* and *Christinus* may be terrestrial or arboreal. However, Orange also noted that while *Cryptoblepharus* and *Menetia* are diurnal lizards, *Hemiergis* and *Christinus* are more crepuscular or nocturnal, and therefore active at the same time as *L. hasselti*, a factor which may bring small active lizards into contact with spiders with more regularity.

The diel activity of lizards in the Perth garden may have an effect on their likelihood to fall prey to *L. hasselti*, but elsewhere diurnal *Crytoblepharus* have been caught and killed by *L. hasselti* (Cook, 1973; Raven, 1990). A more unusual capture concerns a specimen of *Anomalopus verreauxii*, a fossorial skink with greatly reduced limbs (Raven, 1990). The lizard appears to have lifted its head into the sticky lower strands of an almost ground-level *L. hasselti* web, the spider securing the skink's head and hauling it off the ground before repeatedly biting it on the underside to immobilize it. Raven (1990) reports that this skink was not eaten, only immobilized and killed. From the illustration provided, it would seem likely that the skink was too large and heavy for the spider to haul into the web as food and the attack was more defensive than predatory.

Roberts (1941) provides a detailed account of two small lizards, which from the black and white photograph can be identified as skinks, captured in the web of a large female *L. hasselti*, and of the process that followed as the spider bound and killed her quarry. He reports that although the lizards were captured at 0800 hrs, they were still able to struggle ten hours later at 1800 hrs, from which he concluded that *Latrodectus* venom acted more slowly on ectotherms than endotherms. Orange (1990) reports on a small (SVL 114 mm) neonatal Monk Snake (*Parasuta monachus*, as *Rhinoplocephalus monachus*) discovered in the web of *L. hasselti* at 1345 hrs, which was removed from the web but found to be dead 4 hours and 25 minutes later.

Latrodectus species outside Australia have also been documented to occasionally prey on small lizards, e.g. *L. tredecimguttatus* in Croatia (Schwammer & Baurecht, 1988), *L. lilianae* in Spain (Hódar & Sánchez-Piñero, 2002), and both *L. revivensis* (Zilberberg, 1988) and *L. pallidus* (Blondheim & Werner, 1998) in Israel. Curiously most of these records concern lacertids, with only one gecko reported as prey (see Table 2). From North America Neill (1948) provides personal observations of two diurnal skinks in the web of a *L. mactans*, and unverified newspaper accounts of two diurnal snakes predated by either *L. mactans* or *L. variolus* exist (Neill, 1948).

The presynaptic neurotoxin α-latrotoxin is just one of a number of toxins found in *Latrodectus* venom. Whilst α-latrotoxin specifically targets vertebrates, there are other toxins that target insects (latroinsectotoxins) and crustaceans, presumably woodlice (latrocrustatoxin) (Garb & Hayashi, 2013). Because α-latrotoxin is ineffective for killing insects or crustaceans, the primary prey of *Latrodectus* species, its presence in the venom of *Latrodectus* species suggests there must be

an important functional requirement for a vertebrate-specific toxin. If α–latrotoxin is not present in the venom for defensive purposes, it is possible that small vertebrates form a larger part of the diet of *Latrodectus* than previously realized.

Today almost every adolescent or adult in developed countries carries a camera-phone and has the ability to photograph seemingly unusual natural history observations. Unfortunately, the advent of social media means those incidents that are observed and photographed are more likely to be posted on Facebook or Twitter, where they will soon become history as they moved down the page and are lost, than properly documented and submitted for publication as a permanent record. Only by reporting such events in permanent media (i.e. scientific journals) can the frequency of these occurrences be discerned.

ACKNOWLEDGMENTS

The authors express their thanks to Linda Acker (Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main, Germany) for providing a copy of König's 1987 paper on redback spider predation of a gecko, and Max Kieckbusch and Sven Mecke (University of Marburg, Germany) for reading and commenting on an early draft of this manuscript.

REFERENCES

Anderson, L. & Burgin, S. 2008. Patterns of bird predation on reptiles in small woodland remnant edges in peri-urban north-western Sydney, Australia. Landscape Ecology 23: 1039-1047.

Anonymous 1939. Rare case of spider capturing snake in web reported from west. The Telegraph, Brisbane. January 31. p. 2.

Bauer, A.M. 1990. Gekkonid lizards as prey of invertebrates and predators of vertebrates. Herpetological Review 21: 83-87.

Blondheim, S. & Werner, Y.L. 1998. Lizard predation by widow spiders. British Herpetological Society Bulletin 30: 26-28.

Brunet, B. 1994. The Silken Web: A Natural History of Australian Spiders. New Holland, Sydney.

Brunet, B. 1998. Spiderwatch: A Guide to Australian Spiders. New Holland, Sydney.

Cogger, H.G. 2014. Reptiles and Amphibians of Australia. Seventh Edition. Reed New Holland, Chatswood, NSW.

Cook, R. 1973. The wall lizard *Cryptoblepharus boutonii virgatus*. Herpetofauna 6(2): 15-16.

Copland, S.J. 1953. Presidential address, delivered at the Seventy-eigth Annual General Meeting, 25th March 1953, Recent Australian herpetology. Proceedings of the Linnean Society of New South Wales 78: i-xxxvii.

de Rebeira, P. 1981. A redback spider attacking an immature dugite. Western Australian Naturalist 15: 33-34.

Dickman, C.R. & Newsome, T.M. 2015. Individual hunting behaviour and prey specialisation in the house cat *Felis catus*: Implications for conservation and management. Applied Animal Behaviour Science 173: 76-87.

Durigo, B. 2010. This snake's prey became the predator. The Daily Advertiser, Wagga Wagga. March 31. p. 2. http://www.dailyadvertiser.com.au/story/732996/this-snakes-prey-became-the-predator/

Garb, J.E. & Yaashi, C.Y. 2013. Molecular evolution of α–latrotoxin, the exceptionally potent vertebrate neurotoxin in black widow spider venom. Molecular Biology and Evolution 30: 999-1014.

Hódar, J.A. & Sánchez-Piñero, F. 2002. Feeding habits of the black widow spider *Latrodectus lilianae* (Araneae: Theridiidae) in an arid zone of south-east Spain. Journal of Zoology 257: 101-109.

Hoskin, C.J. 2013. A new skink (Scincidae: *Saproscincus*) from rocky rainforest habitat on Cape Melville, north-east Australia. Zootaxa 3722: 385-395.

König, R. 1987. Die Schwarze Witwe (*Latrodectus mactans hasselti* Thorell) als Fressfeind von Reptilien in Australien. herpetofauna (Weinstadt) 9(48): 6-8.

Malpass, L. 2015. Spider v snake: Redback spider wins, snake dies from likely poisoning, Sydney Morning Herald, Sydney. March 3. http://www.smh.com.au/environment/animals/spider-v-snake-redback-spider-wins-snake-dies-from-likely-poisoning-20150303-13tgdf.html

McCormick, S. & Polis, G.A. 1982. Arthropods that prey on vertebrates. Biological Reviews 57: 29-58.

McKeown, K.C. 1936. Spider Wonders of Australia. Angus and Robertson, Sydney.

McKeown, K.C. 1943. Vertebrates captured by Australian spiders. Proceedings of the Royal Zoological Society of New South Wales 63: 16-30.

McKeown, K.C. 1952. Australian Spiders. Angus and Robertson, London.

Metcalfe, D.C. & Ridgeway, P.A. 2013. A case of web entanglement and apparent predation of the skink *Lampropholis delicata* (De Vis, 1888) by the red-back spider *Latrodectus hasseltii* Thorell, 1870 in an autochthonous mesic habitat in coastal southeast Australia. Herpetology Notes 6: 375-377.

Neill, W.T. 1948. Spiders preying on reptiles and amphibians. Herpetologica 4: 158.

Orange, P. 1989. Incidents of predation on reptiles by invertebrates. Herpetofauna 19(1): 31-32.

Orange, P. 1990. Predation on *Rhinoplocephalus monachus* (Serpentes: Elapidae) by the redback spider, *Latrodectus mactans*. Herpetofauna 20(1): 34.

Orange, P. 2007. Predation on lizards by the red-back spider, *Latrodectus hasselti*. Herpetofauna 37: 32-35.

Raven, R. 1990. Spider predators of reptiles and amphibia. Memoirs of the Queensland Museum 29: 448.

Roberts, N.L. 1941. Some notes on Australian spiders. Proceedings of the Royal Zoological Society of New South Wales 61: 38-41.

Schwammer, H. & Baurecht, D. 1988. Der Karstläufer, *Podarcis melisellensis fiumana* (Werner, 1891), als Beute der Europäischen Schwarzen Witwe, *Latrodectus mactans tredecimguttatus* (Rossi, 1790). Herpetozoa 1: 73–76.

Vink, C.J., Derraik, J.G.B., Phillips, C.B. & Sirvid, P.J. 2011. The invasive Australian redback spider, *Latrodectus hasseltii* Thorell 1870 (Araneae: Theridiidae): current and potential distributions, and likely impacts. Biological Invasions 13: 1003-1019.

Webb, J.K., Brook, B.W. & Shine, R. 2003. Does foraging mode influence life history traits? A comparative study of growth, maturation and survival of two species of sympatric snakes from south-eastern Australia. Austral Ecology 28: 601-610.

Wilson, S.K. & Swan, G. 2013. A Complete Guide to the Reptiles of Australia. Fourth Edition. New Holland, Sydney.

World Spider Catalog 2016. World Spider Catalog. Natural History Museum, Bern. Version 17.5. http://wsc.nmbe.ch. Accessed 6 December 2016.

Zilberberg, G. 1988. Behavioural ecology of the widow spider *Latrodectus revivensis*. Shappirit 6: 52-77.

THE ASSOCIATION OF THE BLACK MOUNTAIN ROCK-SKINK *LIBURNASCINCUS SCIRTETIS* AND THE SMALL-LEAVED FIG *FICUS OBLIQUA*

Garry Daly
PO Box 3109 North Nowra 2541.
Email: gaiaresearch@shoalhaven.net.au

The Black Mountain rock-skink *Liburnascincus scirtetis* has a distribution restricted to the piled granite boulders of Black Mountain, some 25 km south of Cooktown, Queensland (Wilson & Swan, 2010). The species' distribution is highly associated with Kalkajaka (Black Mountain) National Park (600 ha) and estimated to be less than 10 ha (Goodman, 2004) within that reserve. A consequence of the species' highly restricted distribution is that the lizard is listed as threatened under the Queensland Nature Conservation Act 1992 (http://www.nprsr.qld.gov.au/parks/black-mountain/culture.html). *Liburnascincus scirtetis* has been recorded by Goodman (2004) eating the fruit of the small-leaved fig *Ficus obliqua* and may be significant in the dispersal of this species. The distribution of *L. scirtetis* is highly associated with the presence of this fig and at times the fruit constitute a considerable proportion of the lizard's diet, which is atypical for a skink of this mass (Goodman, 2004).

On 13 January 2010 numerous *L. scirtetis* were observed at Kalkajaka NP. The animals were observed foraging on the rocks and were observed eating the ripe fallen fruit of *F. obliqua* (Figure 1). Although *F. obliqua* has considerable variation in morphological features across its range, there are no recognised varieties or forms (Dixon *et al.*, 2001), despite the population at Black Mountain being morphologically distinct (pendulous, narrow leaves). In addition to Black Mountain, this variant of *F. obliqua* is found in other rocky habitats across Queensland (K. Kupsch, pers. comm.); however, it is currently unknown whether other skinks eat the fallen fruit of this species at these sites.

ACKNOWLEDGMENTS

I thank Dale Dixon for his clarification on the status of *Ficus obliqua* and two anonymous referees for reviewing the article.

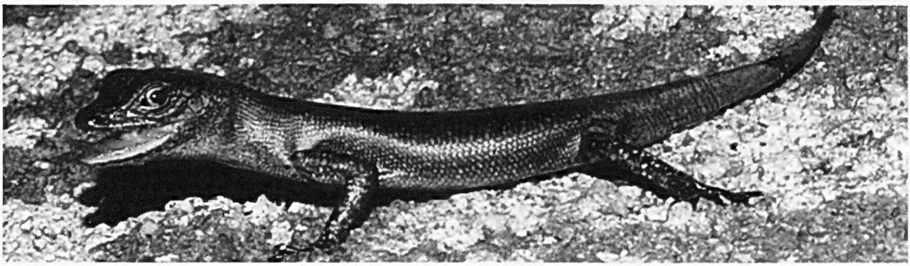
REFERENCES

Dixon, D.J., Jackes, B.R & Bielig, L.M. 2001. Figuring out the Figs: the *Ficus obliqua – Ficus rubiginosa* Complex (Moraceae: Urostigma sect. Malvanthera). Australian Systematic Botany 14: 133-154.

Goodman, B.A. 2004. Frugivory in the Black Mountain rainbow-skink, *Carlia scirtetis* Ingram and Cocacevich, 1980. Memoirs of the Queensland Museum 49: 700.

Wilson, S. & Swan, G. 2010. A Complete Guide to Reptiles of Australia. 2nd edition. Reed New Holland, Sydney.

Figure 1. Black Mountain rock-skink *Liburnascincus scirtetis* eating a fallen *F. obliqua* fruit.



NOTES TO CONTRIBUTORS

Herpetofauna publishes articles on any aspect of reptiles and amphibians. Articles are invited from interested authors particularly non-professional herpetologists and keepers. Priority is given to articles reporting field work, observations in the field and captive husbandry and breeding.

All material must be original and must not have been published elsewhere.

PUBLICATION POLICY

Authors are responsible for the accuracy of the information presented in any submitted article. Current taxonomic combinations should be used unless the article is itself of a taxonomic nature proposing new combinations or describing new species.

Original illustrations will be returned to the author, if requested, after publication.

SUBMISSION OF MANUSCRIPT

Two copies of the article (including any illustrations) should be submitted. Typewrite or handwrite (neatly) your manuscript in double spacing with a 25mm free margin all round on A4 size paper. Number the pages. Number the illustrations as Figure 1 etc., Table 1 etc., or Map 1 etc., and include a caption with each one. Either underline or italicise scientific names. Use each scientific name in full the first time, (eg *Delma australis*), subsequently it can be shortened (*D. australis*). Include a common name for each species.

The metric system should be used for measurements.

Place the authors name and address under the title.

Latitude and longitude of any localities mentioned should be indicated.

Use the Concise Oxford Dictionary for spelling checks.

Photographs – High resolution digital, black and white prints or colour slides are acceptable.

Use a recent issue of Herpetofauna as a style guide.

Manuscripts may be submitted to the editor electronically, via email (gshea@mail.usyd.edu.au) or on CD. Manuscripts submitted electronically must be in Word format, with photographs as separate jpg or tif files.

Articles should not exceed 12 typed double spaced pages in length, including any illustrations.

REFERENCES

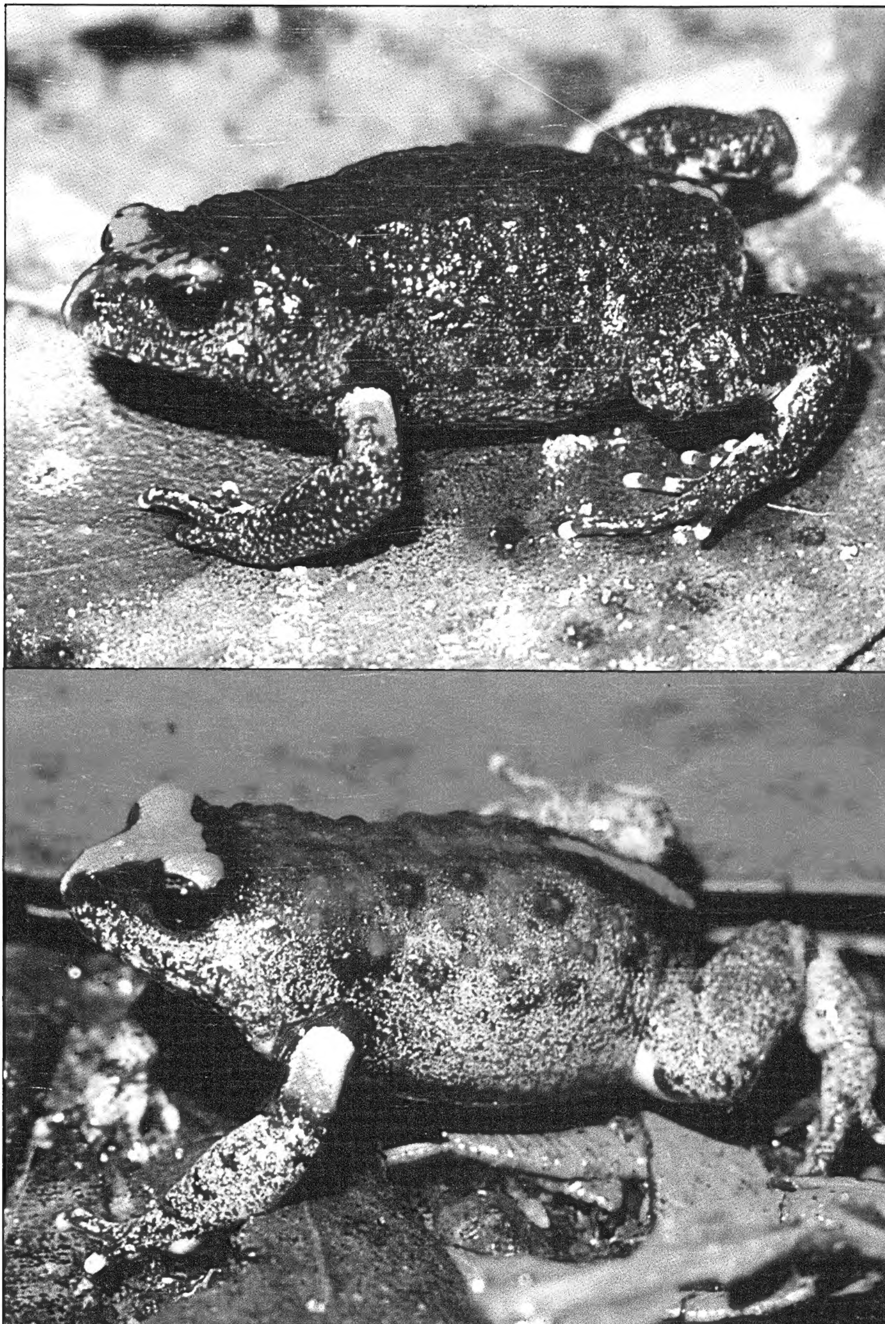
Any references made to other published material must be cited in the text, giving the author, year of publication and the page numbers if necessary. At the end of the article a full reference list should be given in alphabetical order. (See this journal).

Manuscripts will be reviewed by up to three referees and acceptance will be decided by an editorial committee. Minor changes suggested by the referees will be incorporated into the article and proofs sent to the senior author for approval.

Significant changes will require the article to be revised and a fresh manuscript submitted.

REPRINTS

The senior author will receive a PDF copy of their article.



Hybrid between Bibron's Brood Frog (*Pseudophryne bibronii*) and Red-crowned Brood Frog (*Pseudophryne australis*) (top), and Red-crowned Brood Frog (*Pseudophryne australis*) (bottom), from Royal National Park, New South Wales (Photos: A. Payne). See article on p. 2.